ENCLOSURE D

TACTICAL SATELLITE SYSTEMS

Introduction. This enclosure describes the tactical satellite systems found in a joint tactical communications network. Appendix A describes the SHF satellite systems and includes Annex A through H which describe the TD-1389 and TD-1337, AN/TSC-93B(V), AN/TSC-94A, AN/TSC-85B(V), AN/TSC-100A, GMF satellite antijam modem, STAR-T, and LMST. Appendix B describes the MILSTAR, and Appendix C describes UHF satellite systems.

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APPENDIX A TO ENCLOSURE D

SHF SATELLITE SYSTEMS

1. SHF Satellite Systems. To plan the employment of GMF satellite systems, the planner must understand the configurations that can be used to interconnect the different satellite terminals and the allowable circuit configurations through the terminals. The information included in this appendix should be used in conjunction with Annexes A through E and Annexes A and B of Appendix B, which provide details on the individual satellite terminals. The responsibility for engineering the satellite portion of GMF links rests with the appropriate GMF manager for the particular area where the terminals will be deployed. Procedures for requesting access are found in the USAISC "Operation and Control Procedures for the GMF Satellite Communications System." Planners should consult this manual for leadtimes, exact request formats, etc. Network design information for the satellite network must be included at the time the request for satellite access is made. Tactical SHF satellite communications facilities are provided by Phase II GMF satellite terminals. In addition, information is provided on the Phase II AN/TSC-85B terminals the Navy has modified for ship application, the LST-8000, the Challenge Athena, and TROJAN SPIRIT II.

a. The phase II GMF terminals are as follows:

(1) AN/TSC-100A (used by the Air Force).

(2) AN/TSC-94A (used by the Air Force).

(3) AN/TSC-85B (used by the Army, Marine Corps, and the JCSE).

(4) AN/TSC-93B (used by the Army, Air Force, Marine Corps, and the JCSE).

b. Annex A discusses the TD-1389 LRM and TD-1337 TSSP.

c. Annex F discusses the antijam control modem (AJ/CM).

d. The AN/TSC-93B(V)1, AN/TSC-85B(V)1, AN/TSC-94A, and AN/TSC-100A terminals are described in Annex B through E, respectively.

e. Annex G discusses the AN/TSC-156(V)3/4/5 STAR-T.

f. Annex H discusses the AN/TSC-152 LMST.

g. Table D-A-1 lists the baseband equipment for the Phase II GMF terminals.

NOTE: The AN/TSC-100A and AN/TSC-94A do not have echo suppressors or 2/4 wire converters. If required, this equipment must be provided separately.

Table D-A-1. GMF Terminal Baseband Equipment

Satellite Terminal AN/TSC-XX(V)						
Equipment	94A(V)1	94A(V)2	100A(V)1	100A(V)2	85B(V)1	93B(V)1
TD-1389	2	1	6	5	8	3
TD-1337	1	1	2	2	2	1
TED 1/	2	1	6	5	4	2
MX-9635	0	0	0	0	2	1
CV-1548	0	0	0	0	2	1
MD-1026	0	0	1	1	1	0

1/ Marine Corps AN/TSC-93B and the AN/TSC-85B use the KG-194A.

2. System Configurations. Phase II terminals can be operated in point-to-point, nodal, mesh, or hybrid mesh/nodal configurations.

a. Point-to-Point Configuration. This configuration is depicted in Figure D-A-1. Each terminal communicates only with the other terminal. All GMF terminals are capable of operating in this configuration.

b. Nodal Configuration. This type of configuration is depicted in Figure D-A-2. The central or "nodal" terminal is able to communicate directly with all of the peripheral or "nonnodal" terminals. The AN/TSC-94A and AN/TSC-93B are nonnodal terminals, while the AN/TSC-100A and AN/TSC-85B are nodal terminals. The nodal terminals can communicate with up to four nonnodal terminals.

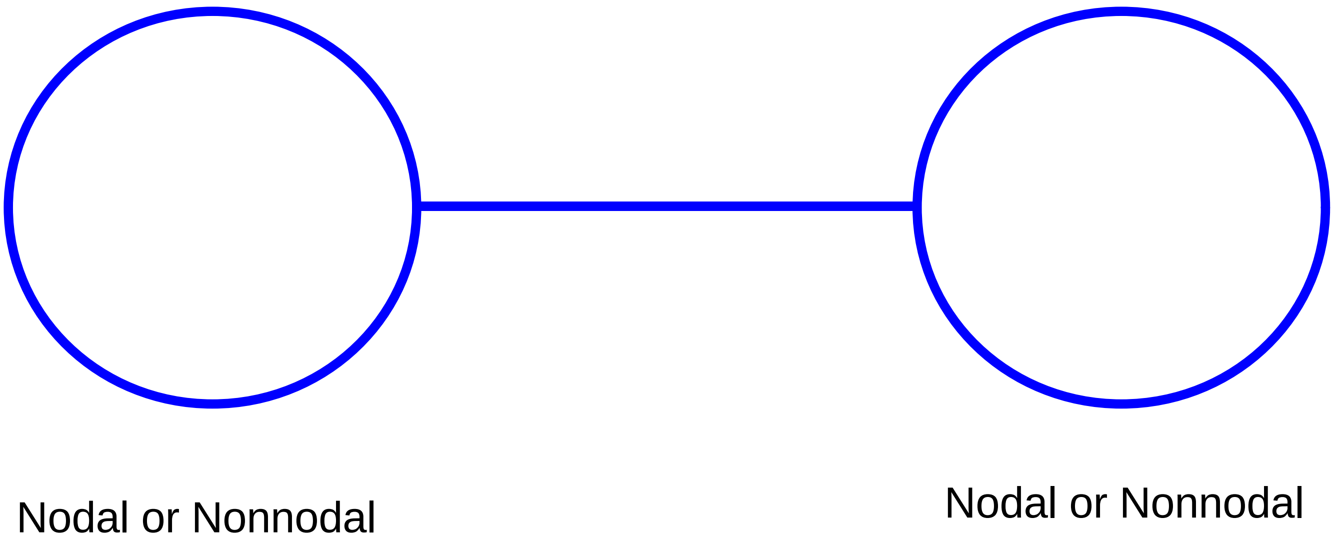

Figure D-A-1. Point-to-Point Operation

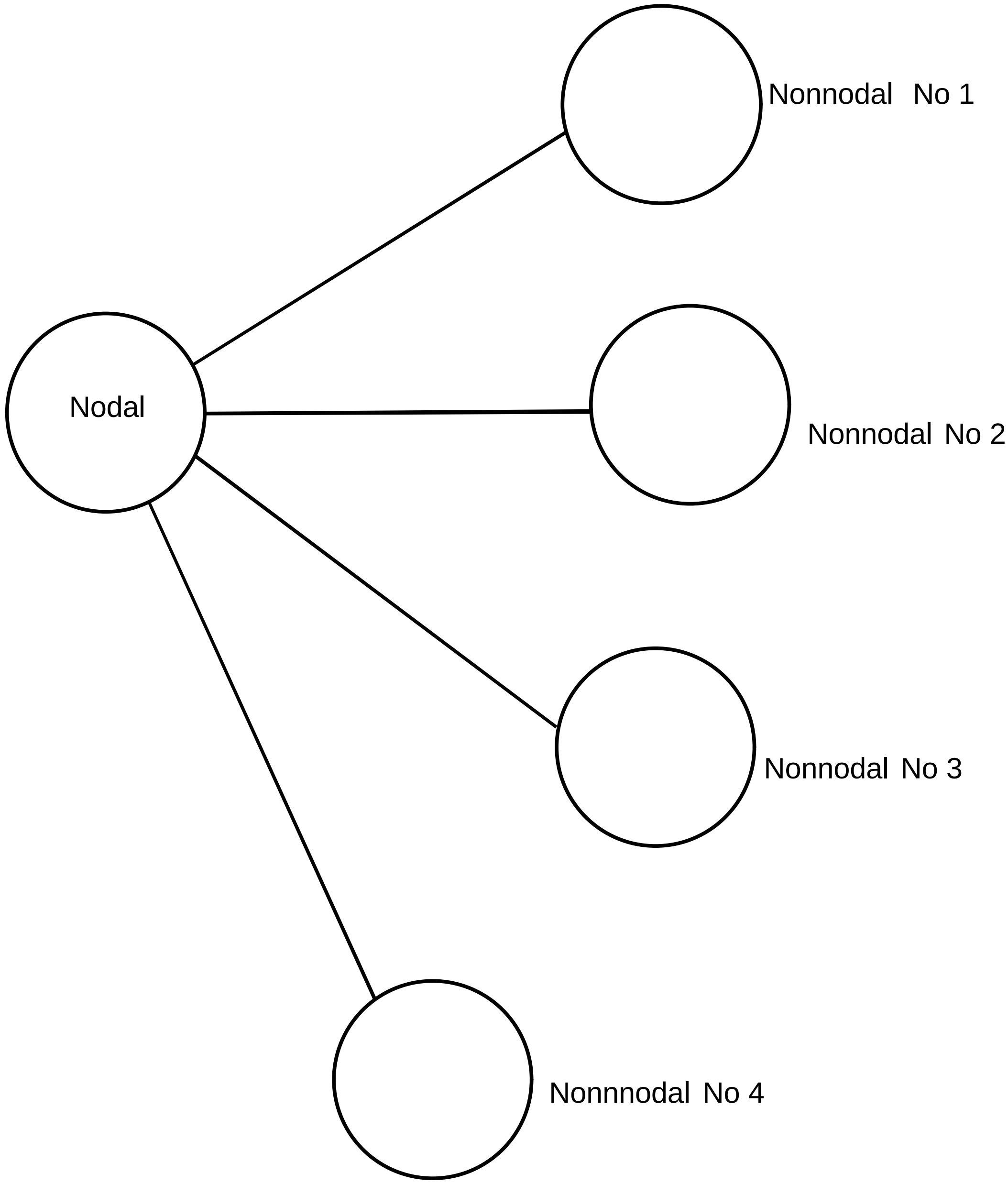

Figure D-A-2. Nodal-Nonnodal Operation Using a Single Carrier
From a Nodal Terminal

c. Mesh Operation. At times, certain nodal units may need to intercommunicate directly with each other. The AN/TSC-100A or AN/TSC-85B can simultaneously communicate with four other AN/TSC-100As or AN/TSC-85Bs with all terminals operating in a nodal mode. Mesh connectivity for the AN/TSC-100A and AN/TSC-85B is depicted in Figure D-A-3. For communications to be possible, the baseband equipment must be compatible.

d. Hybrid Mesh/Nodal Configuration. At times, certain nodal units may need to intercommunicate with both nodal terminals and nonnodal terminals simultaneously. The AN/TSC-100A or AN/TSC-85B can communicate with any combination of up to four AN/TSC-100As, AN/TSC-85Bs, AN/TSC-94As, and/or AN/TSC-93Bs. Hybrid mesh/nodal connectivity is shown in Figure D-A-4.

e. AN/TSC-100A Configurations. The AN/TSC-100A is the most versatile phase II terminal. Two additional configurations (multicarrier and dual satellite) possible with the terminal are discussed below.

(1) Multicarrier Configuration. The AN/TSC-100A can transmit and receive on four separate carriers simultaneously. (See Figure D-A-5). The multicarrier version of the QRA (OE-361(V)1) must be used when more than one carrier is transmitted through one antenna. The signal through the satellite would use one of the configurations discussed earlier.

(2) Dual Satellite Configuration. The AN/TSC-100A is capable of using two different antenna systems and communicating through two different satellites simultaneously. The signal through each satellite would use one of the configurations discussed earlier. The AN/TSC-100A is limited to simultaneously receiving signals from four other terminals. (It cannot use its two TD-1337s and communicate with eight terminals.)

3. Circuit Configurations Through Phase II Terminals

a. Phase II terminals are extremely flexible and can be used in a great number of specific configurations. The circuit configurations shown in subparagraphs 3b through 3e can generally be repeated a number of times in the different terminals. Factors that may become limiting include the following:

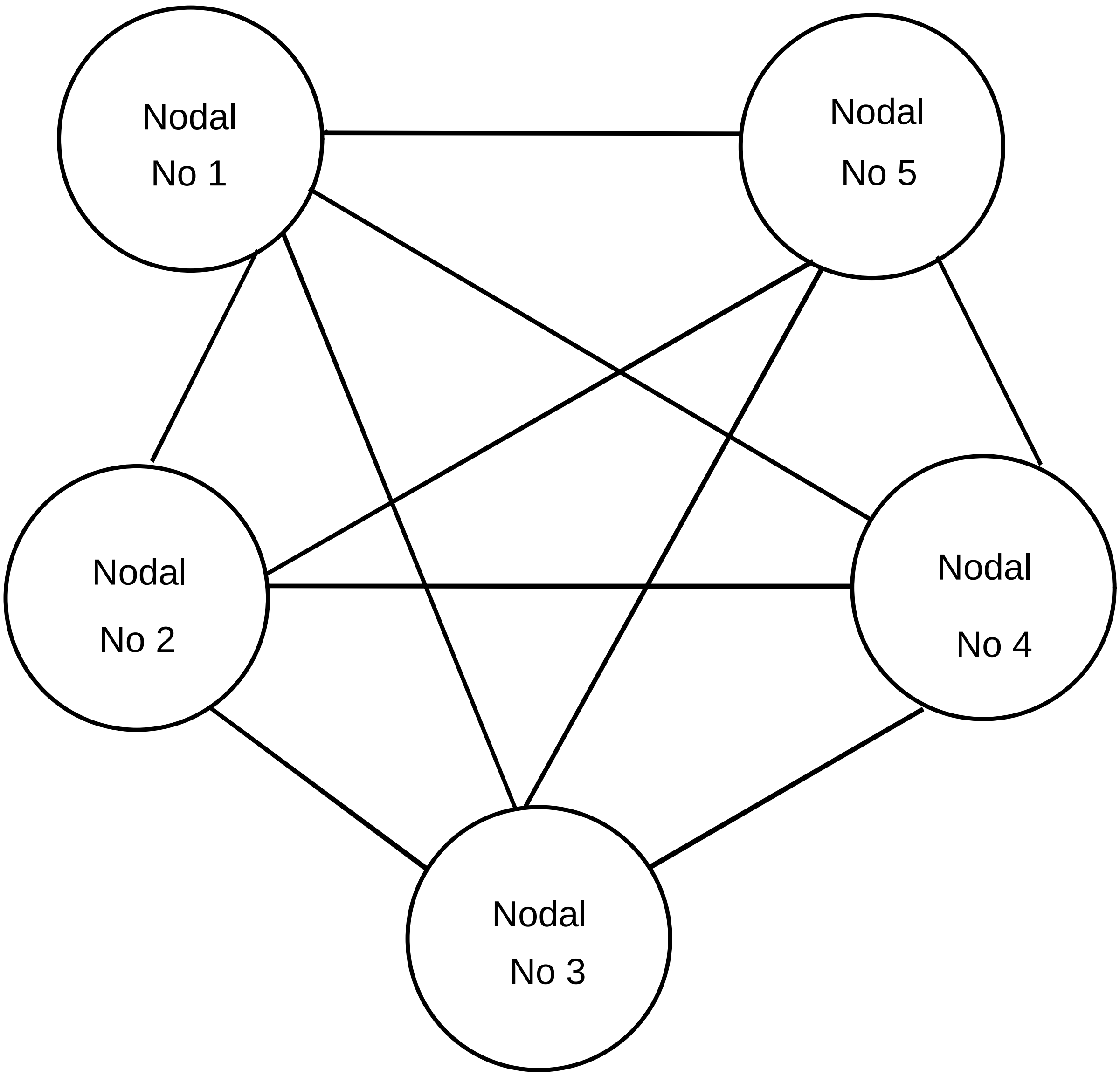

Figure D-A-3. Mesh Operation

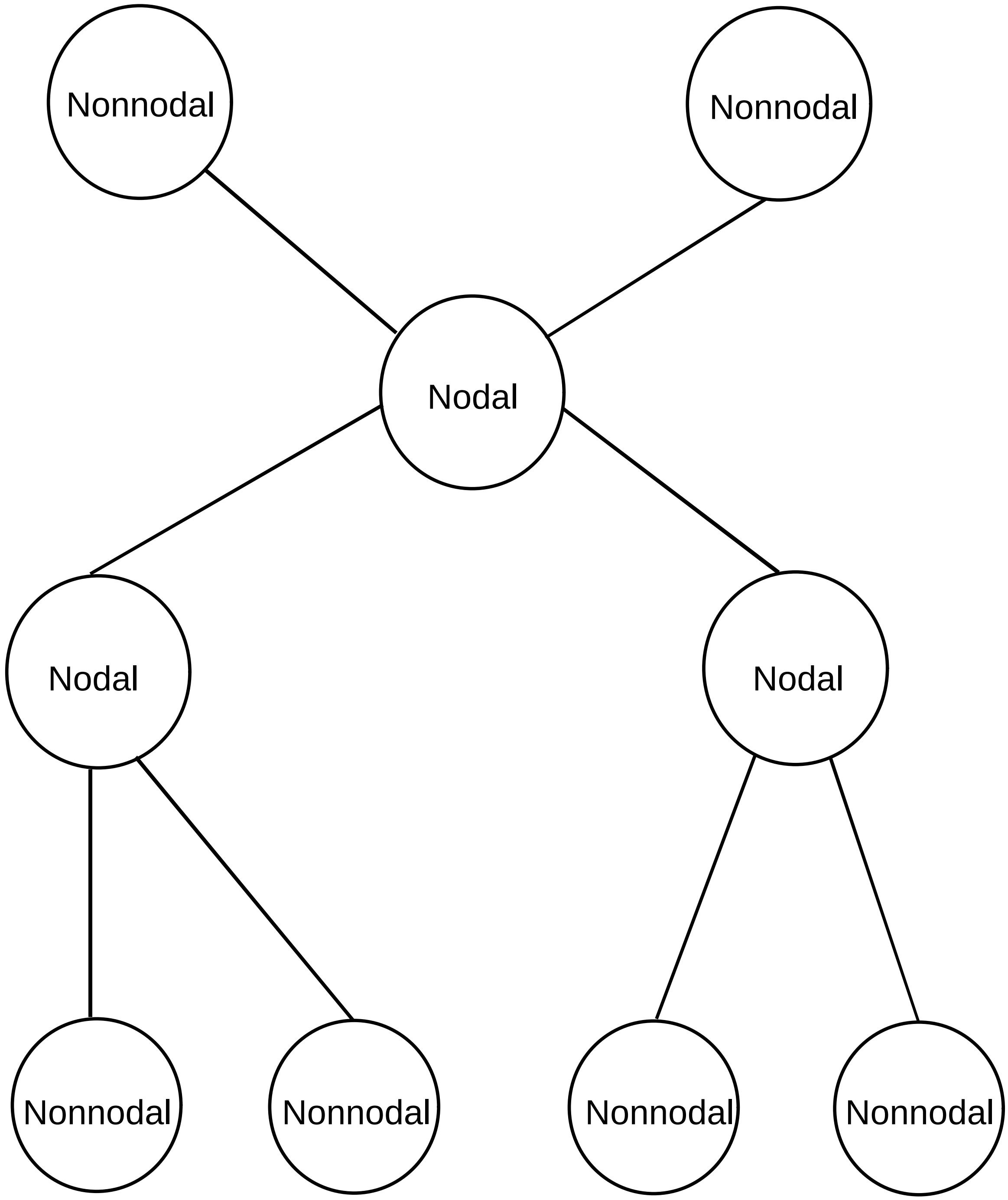

Figure D-A-4. Hybrid Mesh/Nodal Configuration

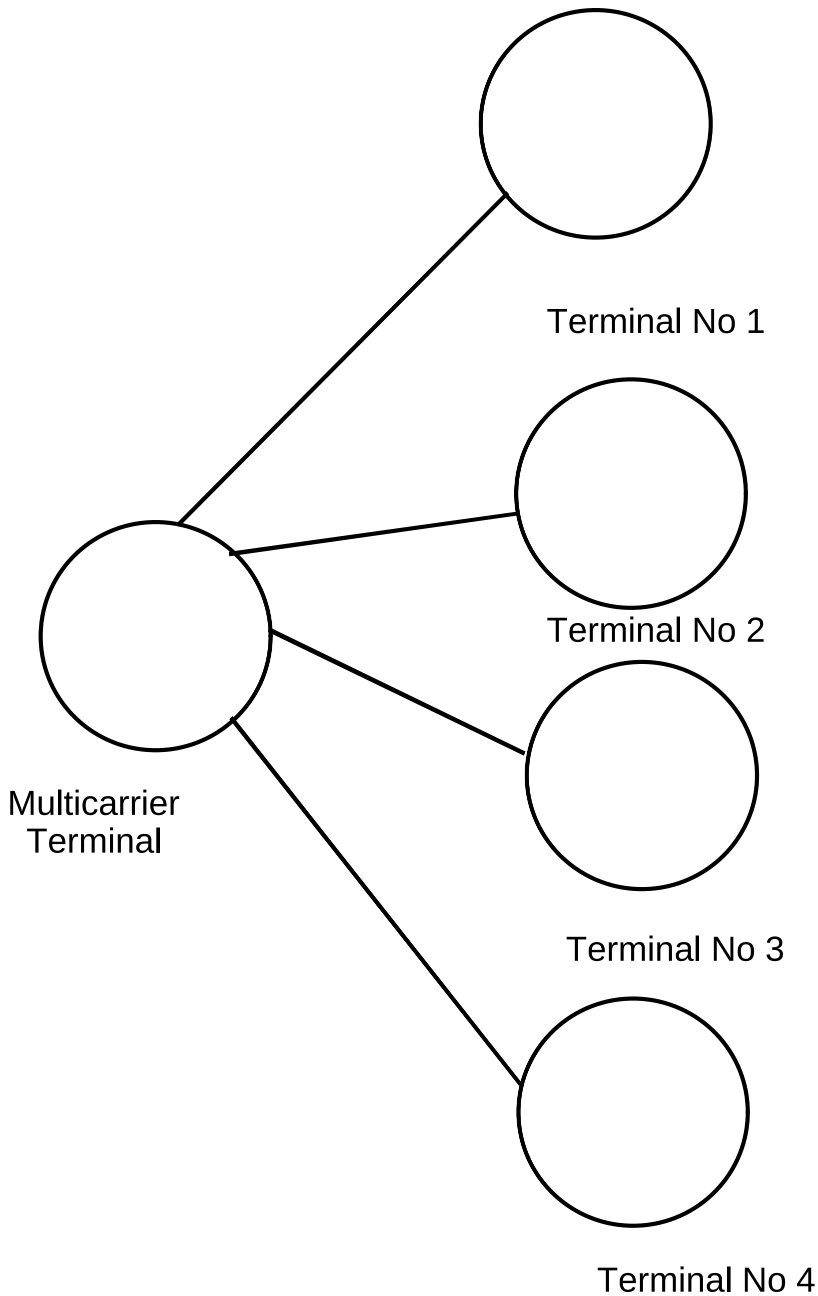

Figure D-A-5. AN/TSC-100A Multicarrier Configuration

(1) The maximum composite rate from a TD-1337 is 4,664 Kbps for a TD-1337(V)1/(V)3 (AN/TSC-85B/100A) and 2,360 Kbps for a TD-1337(V)2/(V)4 (AN/TSC-93B/94A).

(2) The number of earth-side group ports available is eight in a TD-1337(V)1/(V)3 and four in a TD-1337(V)2/(V)4.

(3) The maximum composite rate from an LRM (TSC-93B/94A/85B/100A) is 256 Kbps.

(4) The LRMs can be delivered with a mix of analog voice cards, digital data cards, and FSK cards. The maximum number of the different types of LRM cards (digital, analog, or FSK) available must be obtained from the individual unit.

(5) The maximum number of transmit carriers is one in the AN/TSC-93B, AN/TSC-94A, and AN/TSC-85B and four in the AN/TSC-100A.

(6) The maximum number of receive carriers is one in the AN/TSC-93B and AN/TSC-94A and four in the AN/TSC-85B and AN/TSC-100A.

b. Individual Channel Configuration Through the AN/TSC-85B, AN/TSC-93B, AN/TSC-94A, or AN/TSC-100A. Figure D-A-6 depicts the configuration of single channels that can be supported by each terminal type, as shown in Table D-A-2. Implementation is the same for all LRM-equipped terminals. Entry can be through 26-pair cable or binding posts (AN/TSC-94A/100A only). The LRM can support analog, FSK, CDϕ, or NRZ data. When connecting to a TSSP, the data rate must be 8, 16, 32, 64, 72, 128, 144, or 256 Kbps. (See Annex A for other limitations on data rates, FSK combinations, total number of channels for different data rates, etc.) When connecting to the AJ/CM, the maximum LRM composite rate is 32 Kbps. (See Annex F.)

c. Conditioned Diphase Group Through the AN/TSC-93B or AN/TSC-94A. Table D-A-3 provides detailed information on this configuration, as depicted on Figure D-A-7. Note that a group could enter an AN/TSC-93B or AN/TSC-94A using this configuration and exit a distant AN/TSC-85B or AN/TSC-100A as a group through an MD-1026 as discussed in subparagraph 3d.

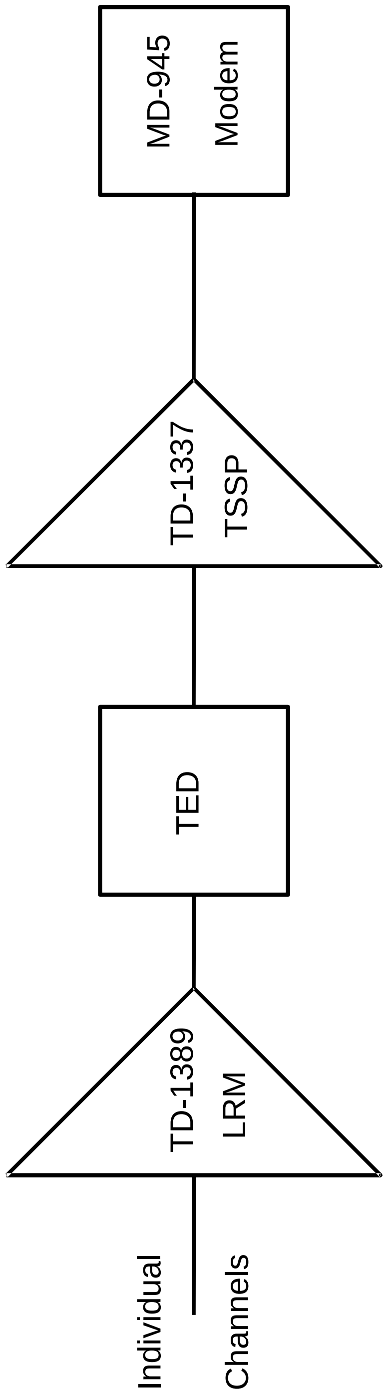

Figure D-A-6. Single Channel(s) Through the AN/TSC-85B/93B/94A/100A

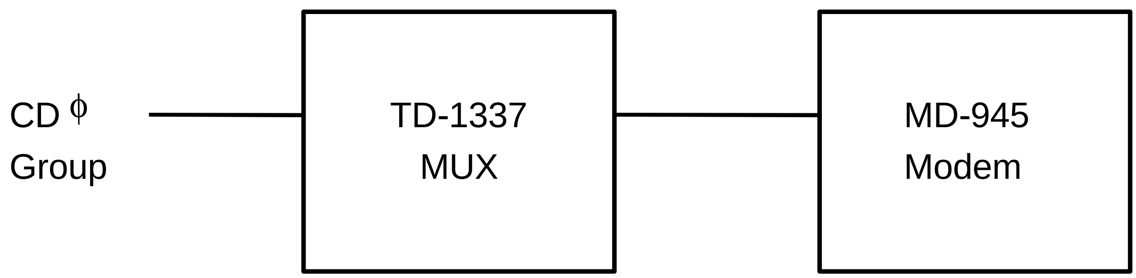

Figure D-A-7. Conditioned Diphase Group Through a TSSP in an AN/TSC-93B or AN/TSC-94A

Table D-A-2. Number of Individual Channels Supported by GMF SATCOM Terminals

Terminal	LRMs	Individual Channels
AN/TSC-85(V)1	8	96
AN/TSC-93B(V)1	3	36 1/
AN/TSC-94A(V)1	2	24
AN/TSC-94A(V)2	1	12
AN/TSC-100A(V)1	6	72
AN/TSC-100A(V)2	5	60

1/ If a group terminates on the TSSP, only 24 can be supported.

Table D-A-3. Conditioned Diphase Group Through Nonnodal Terminals

1. These data apply to the AN/TSC-93B and AN/TSC-94A.
2. The standalone conditioned diphase group input may be operated at 72, 128, 144, 256, 288, 512, 576, 1,024, or 1,152 Kbps. Maximum line side transmission distance is 2 miles for data rates up to 576 Kbps and 1 mile for 1,024 or 1,152 Kbps.
3. Groups must be BLACK when entering the terminal, as no encryption equipment is available.
4. No echo suppressors are available.
5. Entry is via CX-11230 cable.
6. This group always enters TD-1137 MUX port 1. If data rates of 1,024 or 1,152 Kbps are used, MUX port 2 is not available for use.
7. The input from the MD-954 modem enters the TD-1337 through the DEMUX port 1.
8. DVOW is available on this group if the group data rate is 256 Kbps or higher.

d. Digital Group Through an AN/TSC-85B or AN/TSC-100A. This configuration is depicted in Figure D-A-8 and described in Table D-A-4. The groups through the MD-1026 can be either dipulse or conditioned diphase. Dipulse groups through the MD-1026 GM can be operated at data rates of 288, 576, or 1,152 Kbps. The lineside is a constant 2,304-Kbps dipulse signal. This is compatible with the dipulse modems in the AN/TTC-39/39A(V)1 or AN/TSQ-111. The dipulse group modem module has a switch selectable build-out network such that the cable length can be 1/4, 1/2, 3/4, or 1 mile (0.4, 0.8, 1.2, or 1.6 km). The dipulse group modem can accept a repeater power feed. The group modem module loops this current back from the cable receive side to the cable transmit side. This power feed loopback allows a cable system 20 miles long with TD-206 repeaters. Conditioned diphase groups through the MD-1026 GM can be 72, 128, 144, 256, 288, 512, 576, 1,024, or 1,152 Kbps. The maximum transmission distance on the cable side is 2 miles for data rates up to 576 Kbps and 1 mile for 1,024 and 1,152 Kbps.

e. Conditioned Diphase Group Through the LRM and TD-1337. This capability is available in all Phase II GMF terminals. Direct CDϕ interface connectors can be patched directly to the group modem within the satellite interface equipment. This is the preferred means of interfacing at the group level with TRI-TAC switches, MSE switches, CNCE, or other TRI-TAC compatible external equipment. Figure D-A-9 depicts this configuration. Entry to the shelter is via CX-11230 cable. The data rate can be 72, 128, 144, or 256 Kbps. The maximum transmission distance on the cable side is 2 miles. The AN/TSC-94A and AN/TSC-100A can support one group of this type. LRM number one must be used.

4. Navy QUICKSAT SHF SATCOM Terminal. The QUICKSAT is a modified AN/TSC-93B terminal that has been installed on aircraft carriers and selected amphibious flagships. The Navy has 10 QUICKSAT terminals.

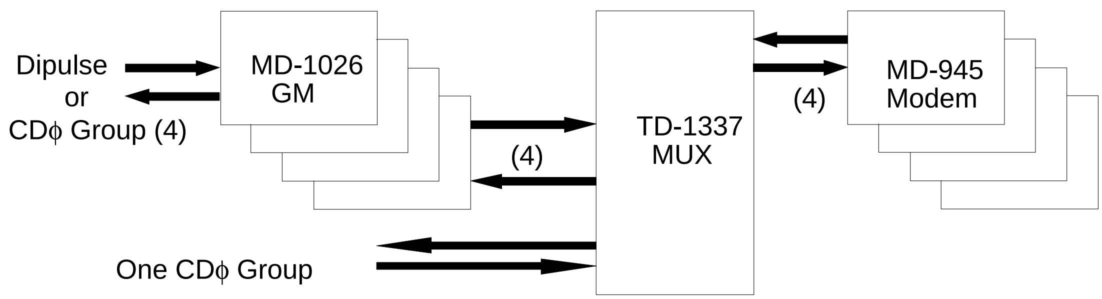

Figure D-A-8. Digital Group Through an AN/TSC-85B and AN/TSC-100A

Table D-A-4. Digital Group Configuration Through Nodal Terminals

1. These data apply to the AN/TSC-85B and AN/TSC-100A.
2. The MD-1026 Group Modem is a component of the AN/TSC-85B and AN/TSC-100A. It can convert up to four dipulse or conditioned diphase groups to a balanced NRZ format compatible with the TD-1337.
3. Maximum line-side transmission distance for conditioned diphase signals is 2 miles for data rates up to 576 Kbps and 1 mile for 1,024 and 1,152 Kbps.
4. Maximum line-side transmission distance for dipulse signals is 1 mile. (When powered from a remote TD-754, pulse restorers could be used to increase this distance.)
5. The standalone conditioned diphase group input to the TD-1337 may be operated at 72, 128, 144, 256, 288, 512, 676, 1,024, or 1,152 Kbps.
6. Groups must be BLACK when entering the terminal, as no encryption equipment is available.
7. No echo suppressors are available.
8. Entry is via CX-11230 cable.
9. The conditioned diphase (standalone) group may be connected to TD-1337 port 1, 3, or 5. If the data rate is 1,024 or 1,152 Kbps, the next higher numbered port (i.e. 2, 4, or 6) is not available for use.
10. The four group inputs from the MD-1026 group modem to the TD-1337 may be connected to the TD-1337 ports 1 through 8. If the group rate is 1,024 or 1,152 Kbps, the group must be assigned to an odd-numbered port; the next higher even numbered port is not available for use.
11. The inputs from the MD-954 modems to the TD-1337 will be on DEMUX port 1, 2, 3, or 4. This choice will depend on which distant GMF terminal is being received.
12. The conditioned diphase (standalone) group must be used for entry to the satellite terminal if 16 Kbps DVOW communication is desired with the CNCE or AN/TSQ-146(V) MUX van that originates the group. The group rate must be 256 Kbps or higher.

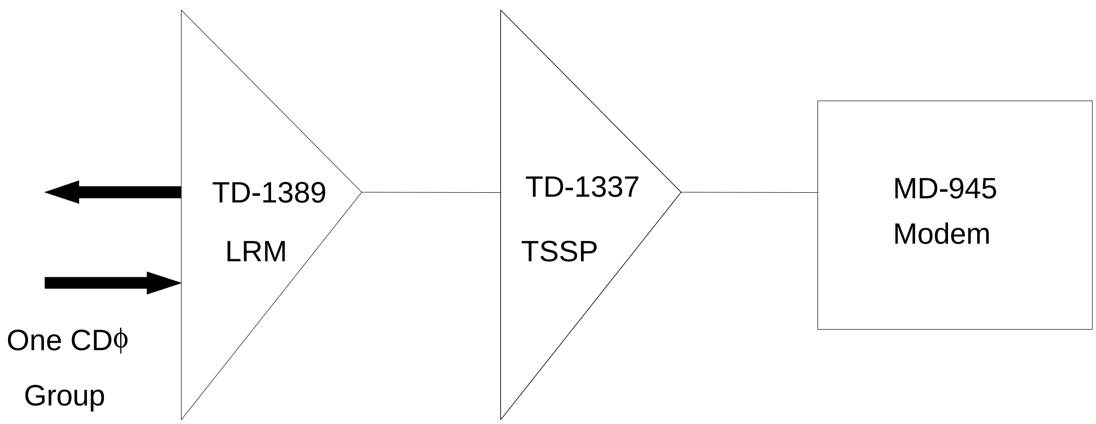

Figure D-A-9. Conditioned Diphase Group Through an LRM and TSSP

a. QUICKSAT Modifications

(1) Antenna. Components of the AS-3399/WSC antenna, used with the AN/WSC-6(V), are mated to the modified AN/TSC-93B terminal. Antenna specifications are provided in Table D-A-5. The antenna system allows for automatic tracking of the DSCS satellite while simultaneously transmitting and receiving. The AS-3399 is a three-axis, 4-foot diameter reflector housed in a radome. The three-axis pertains to elevation, train, and cross-level antenna positioning control. The train axis attaches to the housing that is mounted to the mast or deck.

(2) Modem and Baseband Multiplexer. The modems and baseband multiplexers in the AN/TSC-93B were replaced by the MD-1030/A(V) modem, Comquest CQM-248A multiplexer, TIMEPLEX multiplexer, and AN/FCC-100(V) multiplexer. The MD-1030 is employed with the AN/WSC-6(V)1 SHF SATCOM terminal in-stalled aboard the SURTASS ships and at Navy shore communications facilities. The AN/FCC-100(V) is the standard DISA first level multiplexer and is used on selected Navy afloat platforms and at shore communications facilities.

(a) MD-1030/A(V) Modem. The MD-1030 is a digital self-contained, full-duplex, BPSK modem with a built-in, half-rate error correcting coder/decoder. The modem input data rates are 75 bps to 50 Kbps with error correction coding and 75 Kbps to 500 Kbps without forward error correction coding. The modem provides Table D-A-5. AS-3399/WSC Antenna Technical Specifications a tunable IF input/output interface at 70 MHz center frequency with 100 channel selections at 20 kHz. Aboard ship, the QUICKSAT terminal has one MD-1030 modem that is interoperable with the DSCS OM-73(V)G and MD-1002/G FDMA modems employed with a data buffer (LDP 4-16) for ship motion Doppler correction.

(b) AN/FCC-100(V) Multiplexer. The QUICKSAT installation contains three AN/FCC-100 multiplexers. Each AN/FCC-100 is preconfigured with eight isochronous/asynchronous and eight synchronous cards. Tables D-A-6 and D-A-7 represent typical second and first level MUX channelization plans, respectively, for a QUICKSAT link operating at the preferred 128-Kbps aggregate rate.

Table D-A-5. AS-3399/WSC Antenna Technical Specifications

Specification	Value
Frequency Range Transmit Receive	 7.9-8.4 GHz (Right-hand circular polarization) 7.25-7.75 GHz (Left-hand circular polarization)
Receive Gain/Temperature	11.00 dBi/ 6°K
Maximum EIRP	76 dBw, with 8 kW input power
Power	8 kW
Positioning Accuracy	0.5°
Ship Motion Roll Pitch Yaw Heave Turning	 ± 35° amplitude/7 seconds (sinusoidal) period ± 12°/5 sec. period ± 8.5°/6 sec. period ± 24 ft/4.5 sec. period ± 3°/3 sec.
Weight	590 lbs
Dimensions Height Width Reflector Diameter	 7.1 ft 5.5 ft 4 ft

Table D-A-6. Typical QUICKSAT Second Level AN/FCC-100
Channelization Plan for 32-Kbps Link

Port	Circuit	Data rate (Kbps) 1/	Type	Remarks
1	Orderwire	300 bps	Synchronous	Control Orderwire
2	Dual TACTERM	2.4	Synchronous	Dual ANDVT/KYV-5 access to NCTAMS RWI or point-to-point tactical communications
3	CTAPS	2.4 to 9.6	Synchronous	Remote user access to Air Force TACC CTAPS host
4-5	STU-111/STel Direct Dial (#s 1 and 2)	4.8	Synchronous	Access to PSTN or DSN
6	NAVMACS-MARCEMP	600	Synchronous	NAVMACS access to NAVCOMPARS via MARCEMP for DMS
7-15	Other tactical circuits	--	Various	As required and available
16	1st level MUX input	2/	Synchronous	Aggregate data rate input from first-level multiplexer

Table D-A-6. (Cont d)

1/ Total data rate exceeds 32 Kbps. Lower priority requirements are not provided full-period, dedicated circuits.
2/ Input from first-level LSDTM variable.

Table D-A-7. Typical QUICKSAT First Level AN/FCC-100 Channelization Plan for 32-Kbps Link

Port	Circuit	Data rate (Kbps)	Type	Remarks
1-3	STEL STU-III direct dial (Number 3, 4, & 6)	9.6	Synchronous	Multiple access to PSTN or DSN
4	Joint Deployable Intelligence Support System (JDISS)	4.8 to 56	Synchronous	Developed as LANTDIS under USCINCLANT (J2)
5	Streamlined Alternative Logistical Transmission System (SALTS)	2.4 to 9.6	Synchronous	System for logistic & administrative data exchange
6	Fleet Broadcast	1.2	Synchronous	Multichannel fleet broadcast for retransmission and backup to UHF
7	Tactical Environment Support System (TESS)	2.4 to 9.6	Synchronous	System for environmental support data (weather, atmospheric, oceanographic)
8-16	Other tactical circuits	--	Various	As required and available

b. QUICKSAT Terminal Shipboard Equipment Requirements. Tables D-A-8 and D-A-9 list the required dedicated hardware to support QUICKSAT terminals operating at both 16-Kbps and 32-Kbps rates to include the number of LANTDIS user terminals.

Table D-A-8. QUICKSAT Terminal Shipboard Requirements

	Link Data Rate			
	16 Kbps	Total 16 Kbps	32 Kbps	Total 32 Kbps
MD-1030 /A(V)	1 1/	10	1	10
AN/FCC-100	3	30	3	30
Dual DNVT	1	10	1	10
STEL 9610	1	10	2	20
DAMA Modem			2	20
STATMUX			1	10
CAFMS/CTAPS Remote	1	10	1	10
LANTDIS Remote	1	10	1	10
KG-84A	30	40	50 2/	50

1/ A spare modem is prudent; however, current inventory cannot support two per ship and procurement of additional modems is not planned.
2/ Two KG-84As are required for LANTDIS since no other spares are allocated to the SI space.

Table D-A-9. QUICKSAT Link Orderwire Equipment Requirements

	Navy Standard Teleprinter (NST)	KG-84C
Ship	1	2
Total	10	20

5. LST-8000(V)4-6, SHF Terminal System

a. Introduction. The LST-8000(V)4-6 is a dual-carrier SHF terminal system that provides a transportable means of accessing the DSCS for SHF intercommunications with a gateway earth station or another signal terminal. It is primarily used to establish initial communications during contingency operations. This signal is beamed to the DSCS III geosynchronous satellite for downlink to the gateway station. (See Figure D-A-10.) Signals from the gateway are likewise downlinked by the DSCS satellite to the LST-8000 terminal at 7.25 to 7.75 GHz. The terminal extracts the data from the downlink signal and provides it to the user(s) facility. When an additional converter and modem are available, a second carrier can be interfaced at SHF. The carrier is capable of interfacing special user data circuits like imagery systems, packet data systems, and local/wide area networks using the multirate voice card (MRVC). It can also interface (point-to-point only) with the AN/TSC-85B and AN/TSC-93B utilizing the modem and multiplexer from an additional LST-8000 and bypassing the GMF terminal's TSSP. The LST-8000(V)4-6 terminal is stored in five cases for transport. When configured for operation, the terminal occupies approximately 8 square feet and stands approximately 8 feet high. The system weighs approximately 709 pounds.

b. Terminal Configuration. The LST-8000 terminal consists of four subsystems, as shown in Table D-A-10.

Table D-A-10. LST-8000 Terminal Configuration

Subsystem	Assembly
Antenna	Antenna Waveguide
Modem/Combiner	Signal Combiner Operator Interface Unit Modem ASM/C-B
TWTA/ACU and Power Distribution	Power Distribution Antenna Control Unit TWTA
Terminal Support	Waveguide Equipment Rack

c. Technical Characteristics. Table D-A-11 lists the LST-8000 principal terminal characteristics.

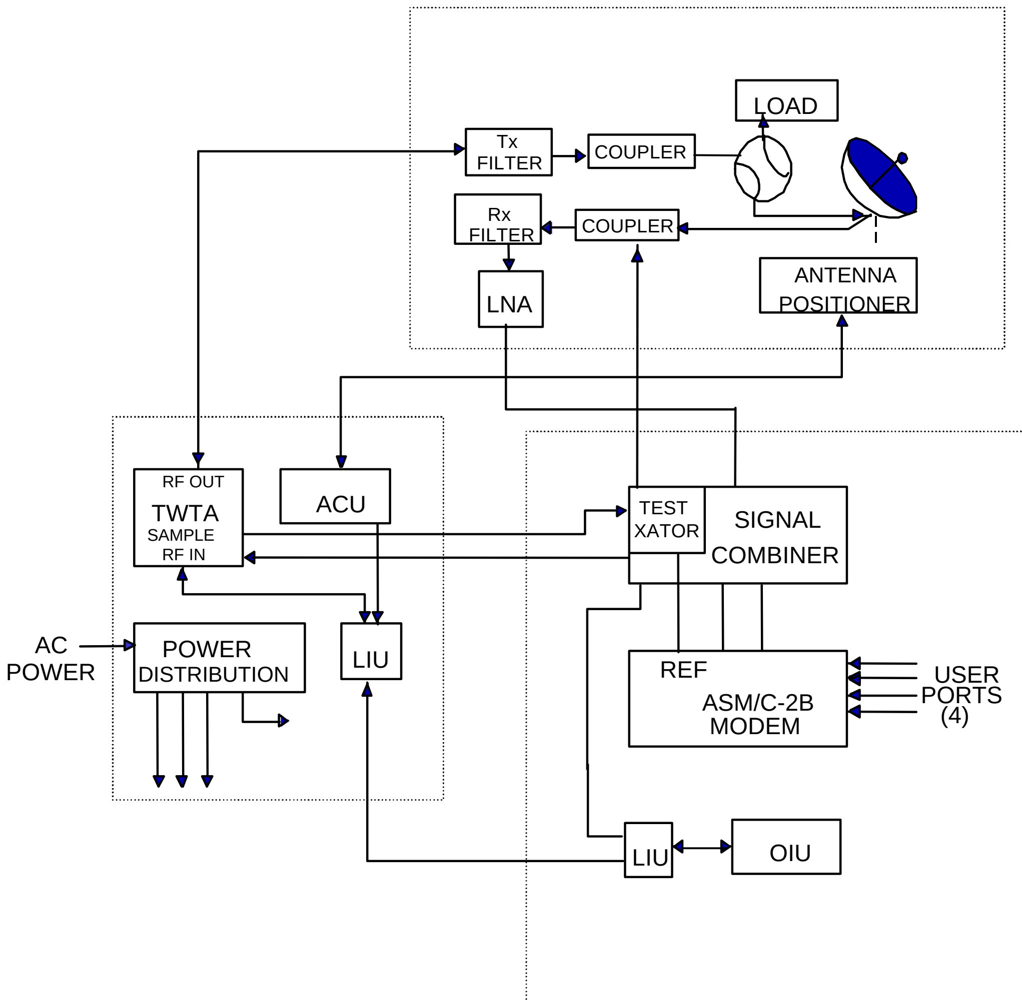

Figure D-A-10. LST-8000(V)4-6 Terminal Function Block Diagram

Table D-A-11. LST-8000 Technical Characteristics

Characteristic	Value
Performance Specifications	
Frequency	7.9-8.4 GHz (transmit) 7.25-7.75 GHz (Receive)
Frequency Resolution	5 kHz increments
Antenna Gain	43.3 dBi (Transmit) 42.5 dBi (Receive)
LNA Noise Temperature	140° Kelvin
System Noise Temperature	208° Kelvin
EIRP	67.25 dBW
Terminal G/T	19.3 dB
Channel Capacity	Two synchronous digital data channels
Coding	Rate ½, Constant length 7
E_b/N_o (10^{-5} BER)	5.2 dB (BPSK and OQPSK)
DAMA Mode Specifications	
Bandwidth	125, 250, 375, or 500 kHz selectable by operator
Maximum Net Members	1,024 worldwide, 64 per local, 4 ports per net member
Relay	Up to 16 simultaneous channels may be relayed per modem. Multiple relays between networks are supported.
Propagation Delay	413 ms per satellite hop (including satellite delay)
Priority/Preemption	7 levels of priority. Both ruthless and temporary preemption are supported.
Terminal Login Time	Typically less than 1 minute.
Circuit Set-up Time	Typically 6 seconds.
General Specifications	
Interoperability	LM 46, MD-1002, and OM-73 in SCPC mode

Table D-A-11 (Cont'd)

Characteristic	Value
Data Rates	Variable from 75 bps to 64 Kbps
Modulation	BPSK, QPSK, OQPSK, GTFM, FSK
Modes of Operation	SCPC, DAMA, CDMA, DSCS, beacon receive mode
Baseband Interface	RS-422/MIL-STD-118: single port in SCPC mode, four simultaneous ports in DAMA mode. Supports KG-84( ) interface

6. Challenge Athena. Challenge Athena is a Navy SHF terminal which provides commercial C-band T1 access to support a CJTF afloat. The services typically provided are listed in Table D-A-12. The allocations are typical but can be reallocated on the fly through the TIMEPLEX multiplexer. The TIMEPLEX will provide an aggregate to both the SHF and Athena RF links. User signals can be switched seamlessly from one path to another without interruption of service. Thus, on the fly restoral in the event of equipment failure or hostile action is possible. Through the use of the preemption features, priorities can be preset to ensure essential services are maintained.

Table D-A-12. Challenge Athena Services

Service	Rate (Kbps)
SCI JDISS/DISNET3/JWICS	56
GENSER JDISS/DISNET1/SIPRNET	56
DSCS Reserved Restoral	128/256
STU-III	352
Primary Imagery	772
Medical	56
PAO	64
VTC	128
POTS	64
Orderwire	64

a. Shore entry points for Athena are commercial sites which have dedicated links to NCTAMS for that theater. Regardless of whether a given circuit is set up on an SHF or C-Band signal, it will ultimately arrive at the same STEP site for further distribution to the distant end.

b. When a situation occurs requiring rerouting, the switching commands triggered locally are transmitted across the network over the orderwire at the start of the next TDMA frame. The distant frame TIMEPLEX responds by looking for the customer signal to arrive on the new aggregate.

c. Unlike conventional multiplexing that must occur in pairs, an intermediate TIMEPLEX can serve both a Demux and Remux function. Therefore, when a customer signal arrives on a new aggregate it will be properly routed to the same tail circuit or aggregate to which it was previously assigned. If the signal went to another aggregate the distant end TIMEPLEX would be unaware that an earlier portion of the path had been altered, unless in making the change the customer signal changed its relative sequence in the TDMA string. Such a change would be reported on the orderwire between the intermediate TIMEPLEX and the distant end.

7. TROJAN Special Purpose Integrated Remote Intelligence Terminal (SPIRIT) II, AN/TSQ-190(V). The TROJAN SPIRIT systems provide a fully functional intelligence dissemination system for ECB and EAC intelligence units. They provide tactical commanders with intelligence tasking, processing, and vertical and horizontal reporting capability, affording split-based operations across the IEW continuum of military operations.

a. System Description. The TROJAN SPIRIT II systems are an integration of data processing, multiplex, encryption, modulation, and RF transmission equipment integrated into a single mobile platform (C- or K_u-Band) or two mobile platforms (X-Band). Transportation of the TROJAN SPIRIT II is by military fixed-wing and rotary aircraft. The systems consist of a primary high mobility multipurpose wheeled vehicle (HMMWV) shelter subsystem with an under-the-hood power generation capability, a power generation equipment (PGE) capability, a quick-erect mobile antenna platform, and a Spare Equipment and Maintenance HMMWV shelter subsystem also with an under-the-hood power generation capability and PGE.

b. Technical Performance. The TROJAN SPIRIT II is capable of operating over commercial and military satellite systems. The system is capable of receiving, storing, displaying, and transmitting digital imagery, weather, and terrain products, templates, graphics, and text between CONUS and OCONUS bases and deployed forces at data rates up to 512 Kbps or T1 (1,544 Kbps if high speed (HS) KIV-7 is installed). It interfaces with the DISN and is fully integrated with the DOD Intelligence Information Systems. It also interfaces with Joint and Service intelligence systems at operational and tactical commands; e.g., JDISS, ASAS, and IAS.

c. Functions. The primary function of the TROJAN SPIRIT II is communications processing and interface. It can receive and transmit imagery, data, reports, and voice communication over 14 satellite channels, 10 of which can handle Sensitive Compartment Information (SCI). It is capable of transmitting and receiving C-, K_u-, X- (3 only), and UHF band commercial or military satellite communications. It contains two server workstations that are common hardware and software compatible. If necessary, Joint Deployable Intelligent Support System (JDISS) or other software can be loaded on these workstations for processing in support of early entry forces.

d. TROJAN SPIRIT Interfaces

(1) A subscriber may directly connect to the TROJAN SPIRIT II SCI Ethernet LAN at the RED entry panel by removing the Ethernet terminator and connecting an Ethernet segment to the entry panel. For planning purposes, extension of the LAN beyond 185 meters requires the use of a bridging device that is not supplied with the TROJAN SPIRIT II.

(2) A subscriber may directly connect to the TROJAN SPIRIT II collateral at the RED entry panel by removing the Ethernet terminator and connecting an Ethernet segment to the entry panels. Extension of the LAN beyond 185 meters requires the use of a bridging device that is not supplied with the TROJAN SPIRIT II.

(3) A subscriber may connect to the TROJAN SPIRIT II BLACK entry panel utilizing a four-wire interface; e.g., KG-84A, in conjunction with a V.22/V.32 modem. The remote subscriber employs a bridge or router to extend the LAN to the TROJAN SPIRIT SCI LAN via the TROJAN SPIRIT CISCO CGS/3 router. The remote subscriber s bridge or router

provides a serial interface to the local KG-84 or KIV-7 for connection to the modem. The remote subscriber's modem slaves its timing to the TROJAN SPIRIT Codex modem and provides the four-wire interface to the TROJAN SPIRIT II. The KIV-7 decrypts the remote subscriber's four-wire data and applies the decrypted data to the serial interface of the CGS/3 router for application to the collateral Ethernet LAN.

(4) In addition to the connectivity to DISNET 1 and 3 discussed above, other RED or BLACK subscribers can interface with the TROJAN SPIRIT II as described below.

e. Auxiliary System Capabilities. As noted above, TROJAN SPIRIT II system is an integration of standard TROJAN data processing and communications subsystems with the following auxiliary subsystems provided as backup communications packages:

(1) A UHF DAMA SATCOM package is utilized to provide a capability for direct, secure, low data-rate communications from TROJAN SPIRIT II equipped divisions to maneuver brigades via the 5 and 25 kHz channels of the AFSATCOM transponders or via an LOS capability. The UHF SATCOM package is an AN/PSC-5 or equivalent unit that has been certified to meet DOD UHF SATCOM architecture requirements. A data interface will be provided between the UHF SATCOM package and the LTNIX notebook computer. The UHF SATCOM will be integrated in a transit case that will be stored inside the PHS with a nominal 9 dB fold-up LRHF antenna. The UHF SATCOM terminal will provide access to the IF at 70 MHz and will be capable of supporting MILSATCOM DAMA implementation.

(2) A GOLDWING HF radio package, consisting of an RF packet radio (AN/GRQ-27(V)), GRID workstation, and secure facsimile, will be utilized to provide a very low rate backup long haul communications capability in the event the SATCOM capability is disabled. A data interface will be provided between the GOLDWING and UNIX notebook computer. The GOLDWING system will be integrated in the PHS. The AN/GRQ-27 is a low density, secure data communications system employing HF FSK packet radio in the 1.6-30 MHz band.

(3) A mobile radio telephone (MRT) will be provided to assist the operator in coordinating link, establishment, and system lineups. The MRT will provide voice only communication between the TROJAN SPIRIT

II operator and the distant end earth station through public switched networks. One MRT will be provided with each TROJAN SPIRIT system.

(4) The commander's tactical terminal-hybrid/receive (CTT-H/R) is provided to interface into the TROJAN SPIRIT II, and provides a receive only UHF capability for the receipt of specific UHF intelligence broadcasts. The CTT-H/R will interface to the UNIX-based workstation via an RS-232 connection to the UNIX workstation for control, status, and receipt of messages.

f. TROJAN SPIRIT Technical Characteristics. See Table D-A-13.

g. IEW Systems Interfaces. As a minimum, TROJAN SPIRIT II will have direct connectivity to the systems listed in Table D-A-14.

8. DSN Entry via GMF Phase II TACSAT. DSN entry via TACSAT terminals is based on use of the CV-4180 Unit (LTU) configured with MFLTU cards for 11 DSN voice trunks and a PSHTI card for a 64 Kbps interface to DDN (DISNET) nodes using a 256-Kbps transmission link to the AN/TTC-39 series or MSE switch. (See Enclosure B for a discussion of the LTU and PSHTI.)

Table D-A-13. TROJAN SPIRIT II Technical Specifications

Characteristic	Value
C-Band	
Transmit Frequency	5.850-6.425 GHz
Receive Frequency	3.625-4.200 GHz
G/T	17.5 dB/EK
EIRP	56 dBW
Antenna	2.4 meters
K_u-Band	
Transmit Frequency	14.0-14.5 GHz
Receive Frequency	10.95-12.75 GHz
G/T	Meets IESS-205
EIRP	59 dBW
Antenna	2.4 meters
X-Band	
Transmit Frequency	7.9-8.4 GHz
Receive Frequency	7.25-7.75 GHz
G/T	29 dB/EK minimum
EIRP (@ low edge of transmit frequency range)	72 dBW
Antenna	6.1 meters
Data Transmission	
Typical	32, 56, 64, 128, 256, 512 Kbps

Table D-A-14. TROJAN SPIRIT II IEW Systems Interfaces

System	Function	Echelon
Teammate	SIGINT	Corps/Division
Trailblazer	SIGINT/DF	Division
Advanced Quickfix	SIGINT	Division
Technical Control Analysis Center	Intelligence Processing	Corps
Tactical High Mobility Terminal	TENCAP/SIDS/ELINT	Division
Mobile Integrated Tactical Terminal	SID/ELINT	Division
TACJAM-A	SIGINT/Jamming	Corps/Division
Improved Guardrail	SIGINT/DF	Corps
Commander's Tactical Terminal	Communications	Corps/Division/ Brigade
Electronic Processing & Dissemination System	ELINT/COMINT	Corps
Imagery Processing Dissemination Station	SID	Corps
Enhanced Tactical Users Terminal	SID/ELINT Processing	Corps/Brigade
All-Source Analysis System	Intelligence Analysis	All echelons
Unmanned Aerial Vehicle	IMINT	Corps/Division
Common Ground Station	Intelligence Processing	Corps/Division/ Brigade
JSTARS	ININT	Corps/Division
Ground Based Common Sensor-Heavy	ESM/ECM	Division
Intelligence Analysis System	Intelligence Processing	USMC

The use of the LTU eliminates the need for the LRM, thereby reducing the number of A/D conversions. The 64-Kbps packet switch interface maximizes the use of bandwidth at the DSN entry point. The DSN entry interface is depicted in Figure D-A-11. Annex B to Appendix A to

Enclosure D and Appendix E of CJCSM 6231.02A provide details on the interface between the AN/TTC-39 series and the DSN using the CV-4180 LTU and Line Type 36.

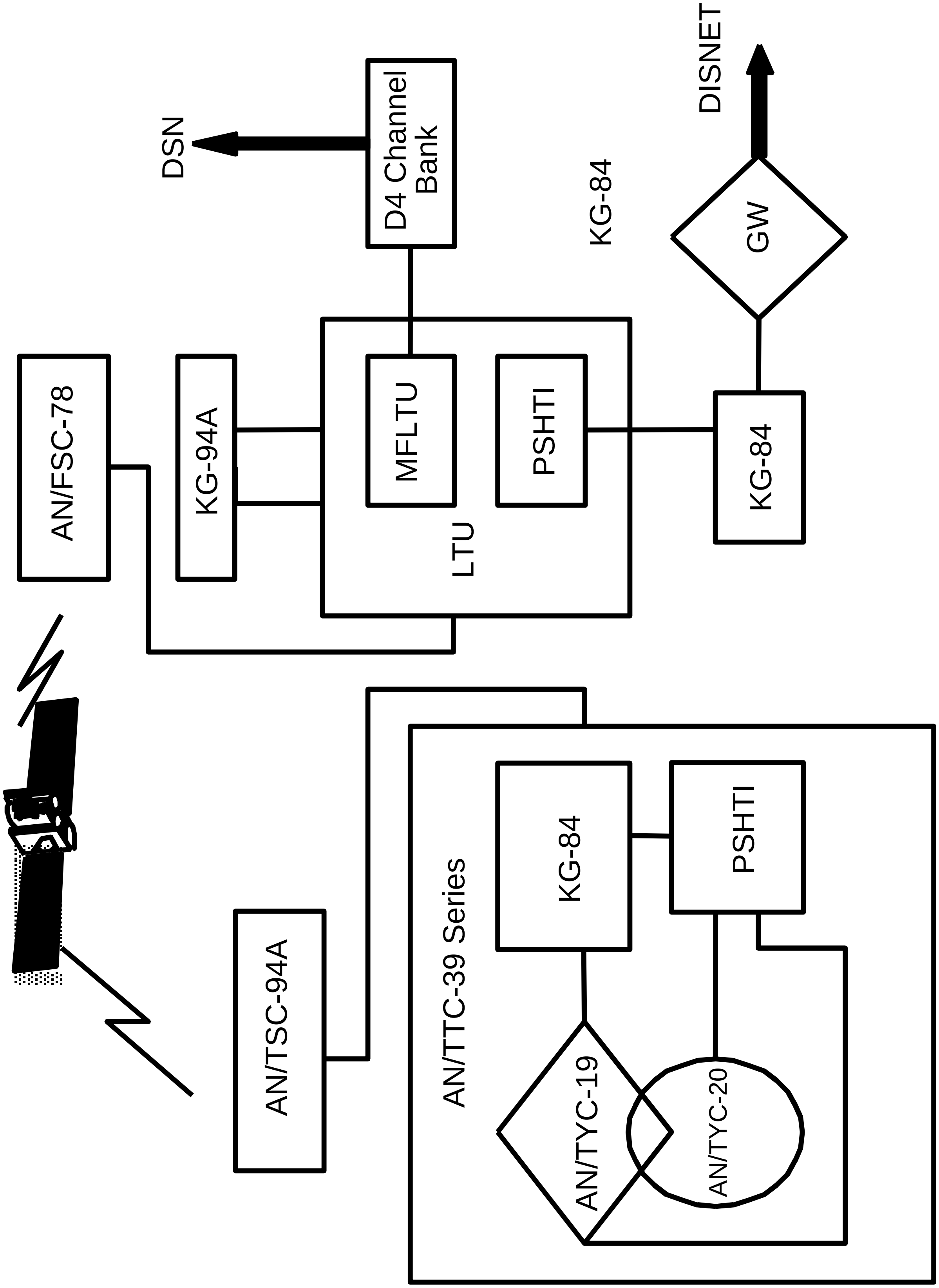

Figure D-A-11. DSN Interface

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ANNEX A TO APPENDIX A TO ENCLOSURE D

TD-1389 LOW RATE MULTIPLEXER AND
TD-1337 DIGITAL MULTIPLEXER

1. Introduction. This annex provides a basic understanding of the multiplex equipment found in the Phase II GMF satellite terminals. Paragraphs 2 and 3 discuss the TD-1389(V) LRM and the TD-1337(V) Digital Multiplexer respectively. Appendix D to Enclosure A provides crew assignment sheets and instructions for use by the planner in planning the configuration for each of the multiplexers in the system.

2. TD-1389(V) LRM. The TD-1389(V) is a microprocessor controlled multiplexer/demultiplexer. The LRM multiplexes (MUX) and demultiplexes (DEMUX) up to 12 channels of digital (NRZ or CDϕ), analog (voice), and FSK signals into a composite data stream for transmission. The composite rate cannot exceed 256 Kbps. The LRM is issued in two versions based on the cooling configuration. The vertically cooled version is designated as the TD-1389(P)(V)1/G, and the horizontally cooled version is designated as the TD-1389(P)(V)2/G. Table D-A-A-1 provides a comparison of the TD-1389(V) interface card requirements. The block diagrams included in subsequent paragraphs are not complete representations of the LRM configuration but are simplified functional diagrams designed to illustrate a particular operating characteristic.

Table D-A-A-1. Comparison of TD-1389(V) Interface
Card Requirements

Initial Issue 1/	Quantity of Cards				
Option	Digital	FSK	CVSD	Composite	Buffer
1	6	6	2	1	0
2	6	0	12	1	0
3	12	6	6	1	0
4	12	0	0	0	1

1/ The initial card complement is provided with one of the four initial options. After issue, the user will be able to return frames less the initial card complement. As requirements change, the user can exchange user's cards through the item manager to meet mission needs.

a. User Interface. User interface to TD-1389(V) LRM is provided by three types of line interface cards (digital, CVSD, and FSK). TD-1389 LRMs are issued with a line module card population as shown in Table D-A-A-1. Operating characteristics of the line module cards are defined by the keypad on the front panel upon system initialization. The characteristics and capabilities of the line module cards are discussed in the subparagraphs below.

(1) Digital User Interface. The digital line card provides interfaces for digital users in a variety of data formats, data rates, and signal types (see Table D-A-A-2). User interfaces may be balanced or unbalanced in MIL-STD-188-144 or TRI-TAC ICD-002. They may be NRZ data and clock, NRZ data and demand clock, NRZ data, or conditioned diphase (CDϕ) data. Data timing can be isochronous (with up to a 250-ppm variation of the external rate from nominal), synchronous, asynchronous in a start-stop character mode (with 5-, 6-, 7-, or 8-bit data and 1-, 1.42-, 1.5-, or 2-bit stop length), or unformatted data without clock. For signal types other than CDϕ, external clock (MUX), recover clock (MUX), demand clock (MUX and DEMUX), and internal clock (DEMUX) are available. If the line interface signal is CDϕ, the timing configuration is automatically established by the LRM processor. (See Table D-A-A-3.) Available data rates vary depending on the type of timing option selected. Table D-A-A-3 lists the data rates available for each timing option with the digital line card. Subparagraph 2b describes the timing options in greater detail.

(2) CVSD User Interface. The CVSD interface card is used to interface analog voice or other voice frequency signals (300-3,400 Hz). This card utilizes CVSD modulation to convert signals to analog at the receiving location. (Note that from a technical standpoint, the card has the same characteristics (except for sampling rates) as the DGM AAU circuit card.) Sampling rates for the conversion are selectable at 16, 19.2, 32, and 38.4 Kbps (19.2 and 38.4 Kbps are primarily used in the AN/GSC-24 mode). The CVSD line card is provided with programmable input and output attenuators and amplifiers as depicted in Figure D-A-A-1. These amplifiers and attenuators compensate for input levels from the analog device to provide approximately -17 dBm at the encoder.

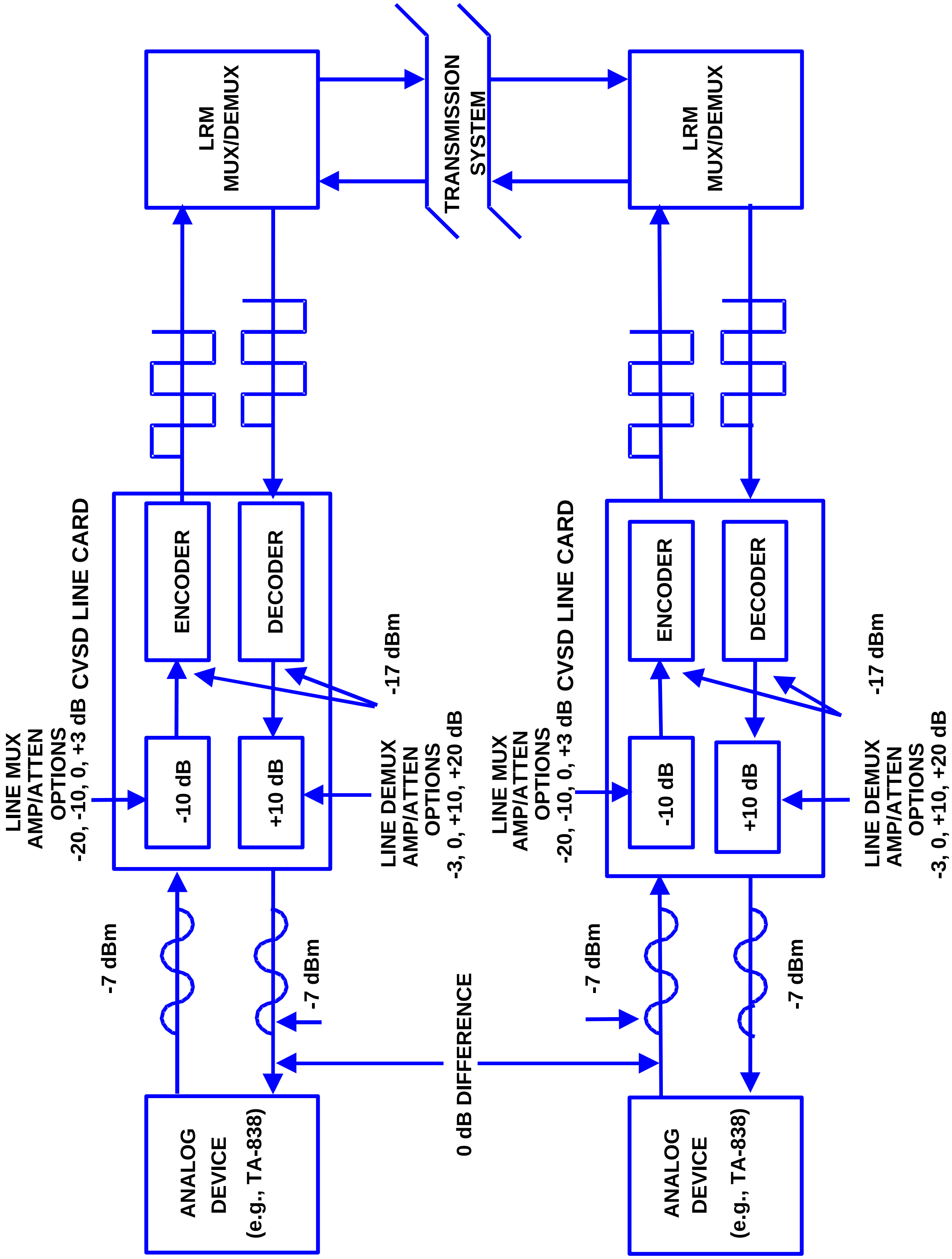


Figure D-A-A-1. CVSD Line Card Level Settings

Table D-A-A-2. LRM Digital Line Data Rates

Timing Options		
External Clk (MUX) Recover Clk (MUX) Demand Clk (MUX & DEMUX) Internal Clk (DEMUX)	Transition Encoded (MUX & DEMUX)	Start-Stop (MUX & DEMUX)
	0-35 Kbps	
37.5		37.5 Kbps
	45.5	44.5
45	45	45.45
45.5	45.45	50
50	50	61.12
56.8	56.8	74.2
61.12	61.12	75
74.2	74.2	100
75	75	110
100	100	150
110	110	300
150	150	600
300	300	1.2 Kbps
600	600	2.4
1.2 Kbps	1.2 Kbps	4.8
2.4	2.4	7.2
4.8		8.0
7.2		9.6
8.0		
9.6		
16.0		
19.2		
32.0		
38.4		
50.0		
56.0		

On the receive side, the proper amplifier/attenuator option should be selected to provide a 0 dB difference across the circuit. On multiple hop systems, where channel breakouts occur at intermediate points, signals should not be converted to analog and back to digital but passed along in a digital format with digital line module cards. Although CVSD line cards can be utilized to process audio FSK, this is not recommended when using the LRM. The CVSD card converts all FSK signals (regardless of data rate) into 16 or 32 Kbps, thereby consuming excessive bandwidth.

Table D-A-A-3. Line Interface Card Timing Options

Signal Type	Timing Options	
	MUX	DEMUX
FSK	Start/Stop Trans Encoded Recovered Clock	Start/Stop Trans Encoded Internal Clock
Digital	Start/Stop Trans Encoded Demand Clock External Clock Recovered Clock	Start/Stop Trans Encoded Demand Clock Internal Clock
Digital-CDϕ 1/	Recovered Clock	Internal Clock
CVSD	NA	NA

1/ The timing configuration for a CDϕ line interface is automatically selected by the LRM processor.

(3) FSK User Interface. The FSK line card permits two tone (mark/space) FSK signals to interface with the LRM without intervening modems. The FSK card extracts both timing and data from the received signal and converts the signal from analog to digital for multiplexing and transmission. The FSK line card at the receiving location converts the digital signal to analog FSK for transmission to the user. Input levels from +7 dBm to -45 dBm are accommodated and output levels from +6 dBm to -15 dBm can be provided. The FSK line card can accommodate synchronous, isochronous (with +250 ppm rate error), or asynchronous data up to 1,200 baud. The data rates available with the FSK line card are listed in Table D-A-A-4. Table D-A-A-5 lists tone pairs and equipment compatibility of the FSK line card.

Table D-A-A-4. FSK Line Card Data Rates (bps)

0.35 1/	56.8	110
44.5	61.12	150
45	74.2	300 2/
45.45	75	600 2/
50	100	1200 2/

Table D-A-A-4. (Cont'd)

1/ Only with transition encoded timing option.
2/ Not with transition encoded timing option.

Table D-A-A-5. LRM FSK Interface Characteristics

Mark Frequency (Hz) 1/	Space Frequency (Hz) 1/
382.5	467.5
552.5	637.5
722.5	807.5
892.5	977.5
1062.5	1147.5
1200	2400.5 2/
1232.5	1317.5 3/
1300	1700.5 4/
1300	2100.5 5/
1402.5	1487.5
1572.5	1657.5
1742.5	1827.5
1912.5	1997.5
2082.5	2167.5
2252.5	2337.5
2422.5	2507.5
2592.5	2677.5
2762.5	2847.5
2932.5	3017.5

1/ Unless specified otherwise, frequencies listed are for use with the Type I modems (MD-700) at rates ≥ 150 baud.
2/ Type II modem (MD-701C/Lenkurt 26C) at 150, 300, 600, and 1,200 baud.
3/ AN/TYC-39 Type I modem frequencies.
4/ TADIL-B at 600 bps.
5/ TADIL-B at 1,200 bps.

b. Digital and FSK Line Card Timing. There are six timing modes to clock user data in and out of the line cards. One of the timing modes described below must be selected for each digital/FSK line card used except those utilizing a conditioned diphase interface.

(1) External Clock. Selection of the "External Clock" option requires a timing source at the user data rate to clock data into the line card.

(2) Recovered Clock. In this mode, timing is recovered from the signal received from the user device. The recovered clock is utilized to clock data into the line card.

(3) Demand Clock. The Demand Clock option can be selected for both the multiplex and demultiplex configuration of the line cards. If this option is selected for the MUX, the LRM provides the timing to clock the data into the LRM. Selection of the Demand Clock for DEMUX requires the user terminal to provide timing to clock data out of the LRM.

(4) Start-Stop Timing. In the start-stop mode, the data characters must contain start and stop bits that enable the LRM to receive or transmit data bits. Reception of a start bit informs the line card to accept data (MUX) or transmit data (DEMUX) and reception of stop bit(s) signals the end of the data character.

(5) Transition Encoded Timing. Transition encoded clock is a variation of recovered clock. Timing is recovered from the user-generated signals. However, the line card is not expecting a continuous data signal in this mode. Timing is recovered from an instantaneous sampling of the user data when data are present.

(6) Internal Clock. In the internal clock mode, the LRM clocks data out of the line card (DEMUX only) using an internally generated timing signal that is equal to the user data rate. The internal clock source may be derived from the LRM's internal crystal oscillator or an external timing source. See subparagraph 2e for LRM system timing options.

c. Composite (Group) Interfaces. The LRM composite interface is capable of operating with a variety of equipment types. This is due to the large number of possible data rates and signal types. The LRM provides three types of composite interfaces to the transmission media: the Composite Interface Module (NRZ), the Composite Modem Module (CDϕ), or the Satellite Buffer Module (used in the (V)4 - strategic version). The composite interface is capable of producing or accepting balanced and unbalanced NRZ with timing or CDϕ signals. (See Figure-D-A-A-2a.) Composite data rates are dependent on the modes of operation described in the subparagraphs below. The following equipment are common direct interfaces for the LRM composite side: TD-1389 LRM, TD-1235 LGM, MD-1026 GM, AN/GSC-24, KG-84A(C), KG-81/94 TED, TD-1337 TSSP, and MD-1131/1132 AJCM.

d. Modes of Operation. The TD-1389(V) has the capability to operate in the six modes described in the following subparagraphs. Five of these modes are operator selectable in the system configuration steps. The Emergency Bypass Mode is initiated by the processor if the bypass mode is enabled during the LRM configuration process.

(1) LRM Mode. In the LRM Mode, up to 12 user channel inputs may be multiplexed and transmitted as a composite signal. The composite data rate is the sum of the channel data rates plus the overhead. All three types of line interfaces (digital, voice, and FSK) can be accommodated in the LRM Mode. (See Figure D-A-A-2 part-b.) The composite group signal includes an interleaved overhead data channel containing control information for framing and adjustment of user data rate. Received composite signals are demultiplexed and provide data to user channels at appropriate rates based on information from the recovered control data channel. The composite data rate is limited to a maximum of 256 Kbps. Possible LRM Mode composite data rates are listed in Table D-A-A-6. There are three methods for selecting the composite rate in the LRM mode. They are defined as follows:

(a) Maximum Efficiency. When this option is selected, the composite rate will be automatically selected such that the ratio of information bits (sum of information bits from all line module cards) to the total number of bits (information plus overhead) in a frame is maximized. The maximum total user data rate (sum of user data rates) is approximately 247 Kbps.

(b) Fixed Resolution. The composite rate is initially determined for maximum efficiency. It is then incremented until a value is reached where the composite bit rate is expressed with exactly three

Table D-A-A-6. LRM Mode Composite Data Rates

50 bps	2.4 Kbps	38.4 Kbps	80.0 Kbps	144 Kbps	192 Kbps
75	4.8	40.0	88.0	152	200
100	8.0	48.0	96.0	153.6	208
110	9.6	50.0	104	160	216
150	16.0	56.0	112	168	224
300	19.2	64.0	120	176	232
600	24.0	72.0	128	184	240
1200	32.0	76.8	136	192	248
					256

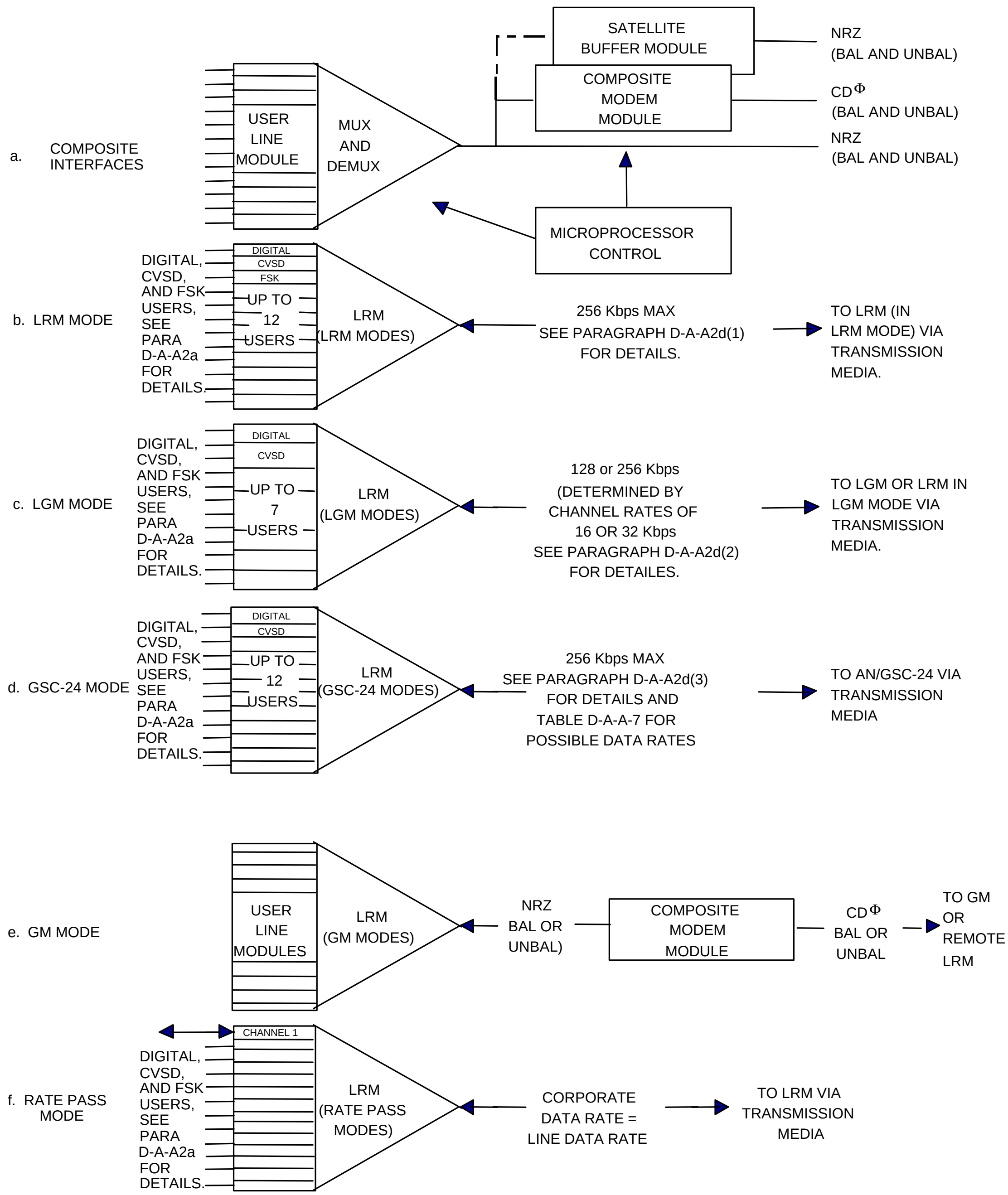


Figure D-A-A-2. LRM Modes of Operation

significant digits. This mode is selectable only for composite rates of 32 Kbps or less.

(c) Specified Rate. The composite rate can be specified by the planner. The allowable rates are defined in Table D-A-A-6. The sum of user data rates plus overhead must be less than or equal to the specified rate.

(2) LGM Mode. When the TD-1389(V) is configured in the LGM mode, it emulates the TD-1234 RMC or TD-1235 LGM. This mode of operation provides seven user channels (16-/32-Kbps digital or CVSD only) at a composite rate of 128 or 256 Kbps (depending on user data rate selection). (See Figure D-A-A-2 part-c.) The LRM FSK line card may not be used in the LGM mode. The overhead channel in the LGM Mode does not provide user data rate information to the distant end, but is used for synchronization and framing only.

(3) AN/GSC-24 Mode. When the TD-1389(V) is configured in the AN/GSC-24 Mode, it emulates and can interface with the AN/GSC-24(V) asynchronous time division multiplexer. As in the LRM Mode, the number of user channels is limited to 12 maximum and the composite data rate is limited to 256 Kbps. (See Figure D-A-A-2 part-d.) The AN/GSC-24 must be configured identically with the LRM with respect to channel assignments. Table D-A-A-7 lists possible AN/GSC-24 mode data rates.

(4) Group Modem (GM) Mode. In this mode, the TD-1389(V) emulates a conditioned diphase module of the MD-1026 Group Modem. No multiplexing or demultiplexing is accomplished by the LRM while operating in this mode, only NRZ to CDϕ conversion. (See Figure D-A-A-2 part-e.) In this modem only mode, an LRM at a satellite ground terminal can be used to interface with a remote LRM or GM over a CX-11230 cable for a distance of up to 3.2 km. In the Group Modem Mode, the LRM is capable of operating at all data rates listed in Table D-A-A-6 for the LRM Mode composite rates. Interface with a GM must use data rates common to both the LRM and GM. These rates are 72 Kbps, 128 Kbps, 144 Kbps, and 256 Kbps.

(5) Rate Pass Mode. In the Rate Pass Mode, single channel operation is established. Channel 1 is connected to the composite interface. Data may be passed unchanged, or NRZ/CDϕ conversion may be performed. Maximum data rate in this mode is determined by the line

card (digital, CVSD, or FSK) utilized for channel 1. (See Figure D-A-A-2 part-f.)

Table D-A-A-7. AN/GSC-24 Mode Composite Rates (bps)

150	543.75	1950	6900	24000	81600
159.375	562.5	2025	7200	25200	86400
168.75	581.25	2100	7500	26400	91200
178.125	600	2175	7800	27600	96000
187.5	637.5	2250	8000	28800	100800
196.875	675	2325	8400	30000	105600
206.25	712.5	2400	8700	31200	110400
215.625	750	2550	9000	32400	115200
225	787.5	2700	9300	33600	120000
234.375	825	2850	9600	34800	124800
243.75252	862.5	3000	10200	36000	129600
53.125	900	3150	10800	37200	134400
262.5	937.5	3300	11400	38400	139200
271.875	975	3450	12000	40800	144000
281.25	1012.5	3600	12600	43200	148800
290.625	1050	3750	13200	45600	153600
300	1087.5	3900	13800	48000	163200
318.75	1125	4050	14400	50400	172800
337.5	1162.5	4200	15000	52800	182400
366.25	1200	4350	15600	55200	192000
375	1275	4500	16200	57600	211600
393.75	1350	4650	16800	60000	211200
412.5	1425	4800	17400	62400	220800
431.25	1500	5100	18000	64800	230400
450	1575	5400	18600	67200	240000
468.75	1650	5700	19200	69600	249600
487.5	1725	6000	20400	74000	
506.25	1800	6300	21600	74400	
525	1875	6600	22800	76800	

NOTE: These are the only AN/GSC-24 rates usable with the TD-1389 (LRM).

(6) Emergency Bypass Mode. This single channel (multiplexing is discontinued) mode of operation results when the processor automatically enables the Rate Pass Mode. The Emergency Bypass Mode is enabled when the processor senses a composite received signal of less than 100 baud. Emergency bypass can only be used in the LRM mode. Line card #1 must be a digital or FSK type card. The processor notifies the operator using an LED on the LRM front panel when the emergency bypass is implemented.

e. LRM System Timing Options. The timing options discussed below are selectable by the operator during system configuration.

(1) Internal Timing. The LRM has an internal timing source that is based on an 8-MHz crystal oscillator (divided down to 4 MHz). The long-term stability of this timing source is ±2 parts per million after temperature has stabilized (± 2°C) within the operative range. In the event of failure of a selected external timing source, the internal timing source will become the primary source of timing and an alarm will be activated.

(2) Receive Composite Timing. The LRM composite demultiplexer input is capable of recovering timing from the received composite signal (NRZ with clock or CDϕ). In this timing mode, the LRM can tolerate a clock whose symmetry is 50 percent ±3 percent, and whose alignment with the data is within 1 microsecond or 25 percent, whichever is greater.

(3) External Timing. The LRM can utilize external timing sources of 5 MHz or the transmit composite rate. Failure of these external sources will cause the LRM to switch to its internal timing source as described.

(4) Channel 2 Input Clock. LRM timing can be derived from a remote source (at rates of 16 and 32 Kbps) in CDϕ or NRZ with timing signal formats. This timing is recovered from the signal received at the channel 2 user input.

f. Application. This section contains information to assist system planners in determining proper LRM operating characteristics and provides a method of communicating these operating characteristics to equipment operators.

(1) Configuration Planning. The planner determines LRM configuration using operational requirements. Because of its versatility, configuration can be a complicated process. Figure D-A-A-3 provides a roadmap for LRM configuration for the five modes of operation. There are five major areas that require definition in order for the operators to configure the LRM for operation (except for GM Mode). These areas are system configuration, multiplex line, multiplex composite, demultiplex line, and demultiplex composite.

(2) System Configuration. System configuration determines the primary operating characteristics such as system mode, timing reference, choice of encryption equipment, resync options, etc. Generally, system

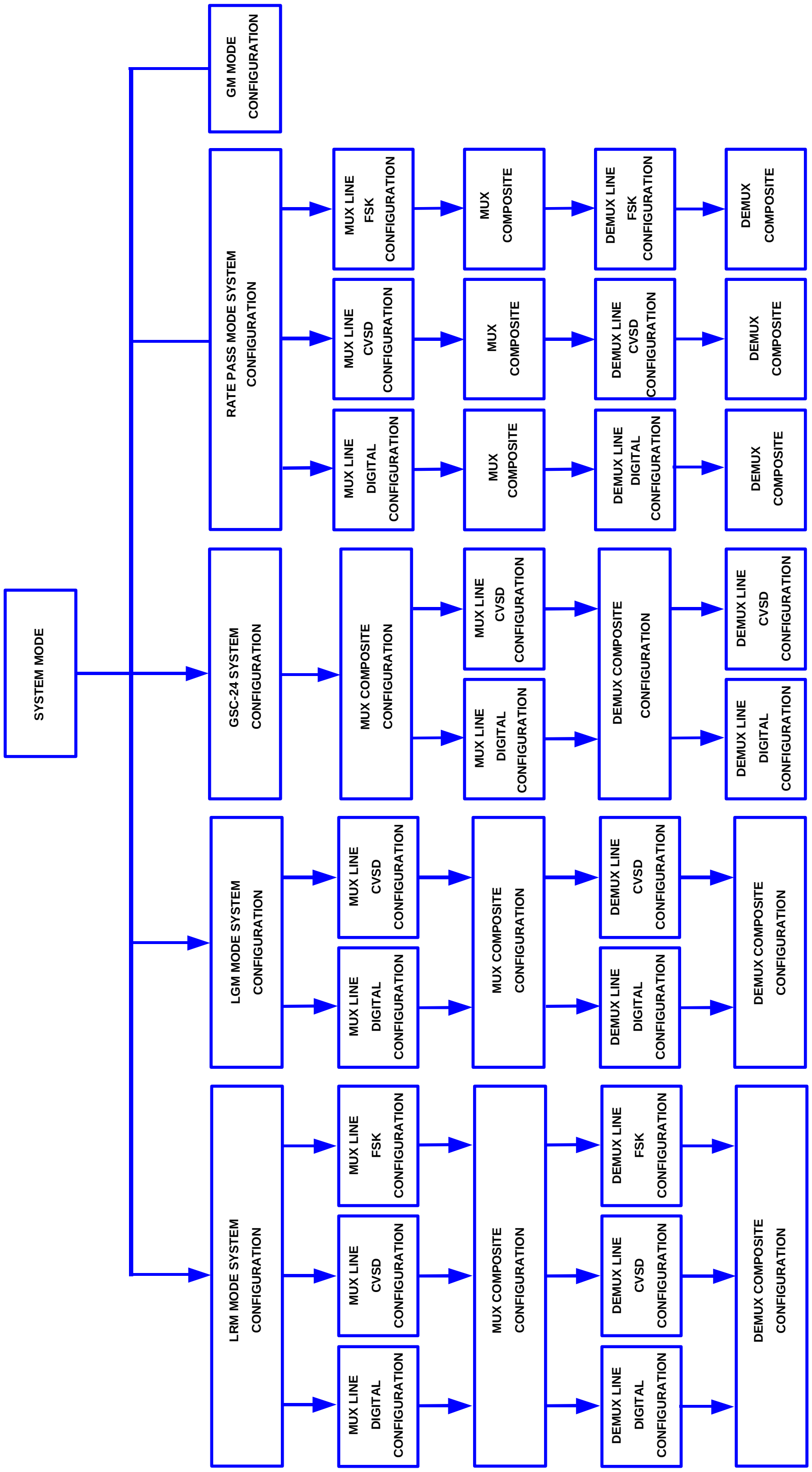


Figure D-A-A-3. LRM Configuration Road Map configuration options are determined by distant end multiplexer-demultiplexer requirements. For example, if an AN/GSC-24 is the MUX/DEMUX in use at the distant end, the AN/GSC-24 Mode must be utilized. If the distant end MUX/DEMUX is a AN/TTC-39 series or AN/TSQ-111, the LGM Mode must be used in order to obtain the proper MSF. In a situation where the distant end breaks out all channels to individual dedicated users, either the LRM Mode or LGM Mode can be used.

(3) Multiplex/Demultiplex Line Configuration. The multiplex and demultiplex line characteristics are determined by line-side user interface requirements. This includes selection of the correct line module card and options selected for that card during configuration. The LRM provides both balanced and unbalanced interface characteristics for NRZ and CDϕ signals. TRI-TAC equipment can accommodate only balanced NRZ and CDϕ on the user (loop) side and balanced NRZ or unbalanced CDϕ on the group side. The Group Modem Mode does not require the use of a user line card; therefore, no configuration steps are required for the multiplex/demultiplex line characteristics.

(4) Multiplex/Demultiplex Composite Configuration. The MUX/DEMUX composite characteristics are primarily to provide a compatible interface with the directly connected (composite side) equipment. As stated above, interface to TRI-TAC equipment at the group level can only be accomplished by balanced NRZ and/or unbalanced CDϕ. Certain programmable options for composite characteristics are also determined by the multiplex/demultiplex equipment in use at the distant end (i.e., composite data rate).

g. LRM Interface Characteristics. Table D-A-A-8 lists user equipment interface characteristics. Characteristics for equipment that interfaces with the LRM on the composite side are listed in Table D-A-A-9.

h. Crew Assignment Sheets. Appendix D to Enclosure A contains CASs and instructions for the LRM for use in providing the informational interface between system planner and operators. These forms provide all information required by operators to configure the TD-1389 MUX/DEMUX for operation.

3. TD-1337(V) Digital Multiplexer. The TD-1337(V)G TSSP is a synchronous time division digital multiplexer used in GMF satellite earth

Table D-A-A-8. LRM User Equipment Interface Characteristics

Type Interface	Characteristics
FSK Interfaces	
AN/UGC-74	
Codes	BAUDOT (ITA 2), or ASCII (ITA 5)
Data Rates	45.5, 50, 75 bps (ITA 2)
Stop Length	75, 150, 300, 600, 1200 bps (ITA 5)
Interface	Bal NRZ or Bal CDϕ in ASCII code at rates from 300-1200 inclusive
AN/UGC-129	
Codes	BAUDOT (ITA 2), ASCII (ITA 5)
Data Rates	45.5, 50, 75 bps (ITA 2) 75, 150, 300, 600, 1200, 2400 bps (ITA 5)
Stop Length	1 or 2 bits
Interface	Unbalanced NRZ
AN/UGC-144	
Codes	BAUDOT (ITA 2), ASCII (ITA 5)
Data Rates	45.5, 50, 75 bps (ITA 2) 75, 150, 300, 600 1200 bps(ITA 5)
Stop Length	Asynchronous ITA 2: 2 bits Asychronous ITA 5: 1 or 2 bits
Interface	Balanced NRZ or CDϕ
Modem Interfaces	
Type II Modem (MD-701C/Lenkurt 26C/Frederick 1280)	
Data Rates	150, 300, 600, or 1200 bps
Mark Frequency	1200 Hz
Output Level	2400 Hz
Input Level	0 to -30 dBm
TADIL-B Modem	
Data Rates:	600 or 1220 bps
Mark Frequency	1300 Hz
Space Frequency	1700 Hz @ 600 bps, 2100 Hz @ 1200 bps
Output Level	0 to -20 dBm (adjustable in 2dB steps)
Input Level	-13 dBm
CVSD	Interfaces
TA-720 and TA-838	Set instrument to 4-wire and ac supervision. Configure CVSD line module to 16 or 32 Kbps (depending on distant end MUX/DEMUX) and set Line MUX and DEMUX levels (L01M & L01D) to -10 dB and + 10 dB respectively

Table D-A-A-8. (Cont d)

Type Interface	Characteristics
Digital Interfaces	
KY-68 Data Rate Signal Type	 16 or 32 Kbps Balanced CDϕ
TA-954, TA-1035, TA-1042	Cannot be interfaced with Line Module Cards. The DNVT has no provision for local battery and must obtain power via its interface cables.
TRI-TAC DGM Equipment he following equipment can interface with the digital line cards in the LRM at a channel level for drop-and-insert applications: TD-1233, TD-1234, and TD-1235. Data Rates Signal Type	16 or 32 Kbps Balanced CDϕ
KG-84A (Digital) Data Rates NRZ Balanced CDϕ	 50, 75, 100, 110, 150, 300, 600 bps 1.2, 2.4, 4.8, 8.0, 9.6, 16, 32 Kbps 1.2, 2.4, 4.8, 8.0, 16, 32 Kbps
TD-1069 Data Rate Signal Type	 32 Kbps Balanced CDϕ
TD-1337 Data Rates NRZ CDϕ	 8, 16, 32, 64, 72, 128, 144, 256 Kbps 72, 128, 144, 256 Kbps
KG 81-94 See Original KG-84 Data Rates NRZ (Bal or unbal) CDϕ	 50, 75, 100, 110, 150, 600, 1200, 2400, 4800, 9600, 16000, 32000 bps 1.2, 2.4, 4.8, 8, 16, 32 Kbps

Table D-A-A-8. (Cont d)

Type Interface	Characteristics
MD-1026 Data Rates Type Interface	 72, 128, 144, 256 Kbps Unbalanced CDϕ
MD-1234 (LGM mode only) Data Rates Type Interface	 128 or 256 Kbps Unbalanced CDϕ
TD-1235 (LGM mode only) Data Rates Type Interface	 128 or 256 Kbps Balanced NRZ
The LRM composite signal can be multiplexed by the TD-1236 or TD-1237 into TRI-TAC supergroups. The LRM may be operated in any mode as long as the data rate and interface characteristics are met. The distant end group multiplexer must be configured in an identical fashion. The only exception to this rule is if the LRM composite signal is to be connected to the Group 1 input of the TD-1235. In this case, a TRI-TAC multiplex signal format must be utilized. This means the LRM must be operated in the LGM mode at 128 or 256 Kbps. Data Rates Type Interface	 72, 128, 144, 256 Kbps Balanced NRZ

Table D-A-A-9. LRM Composite Side Equipment Interface Characteristics

Equipment	Interface Characteristics
TD-1337 Data Rates NRZ CDϕ	 8, 16, 32, 64, 72, 128, 144, 256 72, 128, 144, 256 Kbps
KG-81/KG-94 Data Rates Type Interface	 All LRM rates, 9.6-256 Kbps inclusive Balanced or unbalanced NRZ

Table D-A-A-9. (Cont d)

Equipment	Interface Characteristics
KG-84A	
Data Rates	
NRZ (bal/unbal)	50, 75, 100, 110, 150, 300, 1200, 2400, 4800, 8000, 16000, 32000 bps
Balanced CDϕ	1.2, 2.4, 4.8, 9.6, 16, 32 Kbps
MD-1026	
Data Rates	72, 128, 144, 256
Type Interface	Unbalanced CDϕ
TD-1234 (LGM mode only)	
Data Rates	128, 256
Type Interface	Unbalanced CDϕ
Type Interface	Characteristics
TD-1235 (LGM mode only) 1/	
Data Rates	128, 256
Type Interface	Balanced NRZ
TRI-TAC Group Multiplexers 2/	
Data Rates	72, 128, 144, 256
Type Interface	Balanced NRZ

1/ Interface with an LGM will probably only be required via some type of transmission system. Direct composite interface between an LRM and an LGM can only be supported at a distance of 100 feet or less.

2/ The LRM composite signal can be multiplexed by the TD-1236 (TGM) or TD-1237 (MGM) into TRI-TAC supergroups. The LRM may be operated in any mode as long as the data rate and interface characteristics are met. The distant end group multiplexer must be configured identically. The only exception to this rule is if the LRM composite signal is connected to the Group 1 input of a TGM. In this case, a TRI-TAC MSF must be used. This means the LRM must be operated in the LGM mode at 128 or 256 Kbps.

terminals. It provides a full duplex capability in interfacing the modem in the terminal radio equipment with group equipment. Inputs from synchronous data users are multiplexed into a supergroup and supplied to the modem in the terminal radio equipment for transmission. Similarly, received supergroups are demultiplexed into their composite parts and supplied to the respective users. There are four models in the TD-1337 family: (V)1/G (used with the AN/TSC-85B); (V)2/G (used with the AN/TSC-93B); (V)3/G (used with the AN/TSC-100A); and (V)4/G (used with the AN/TSC-94A). Subparagraph a provides general information on the TD-1337. The connectivity possible with the TD-1337 is discussed in subparagraph b. Finally, the considerations necessary in establishing databases and the entries required on database forms are discussed in subparagraph c.

a. Functional Description. Each TD-1337 model has different functional capabilities. The satellite side interfaces with the MD-945 modem equipment. The earth-side interfaces with various equipment such as the TD-1389 LRM, TD-660 multiplexer, and the TRI-TAC family of DGM multiplexers and modems. Earth-side interfaces are subdivided into the following four categories: group interfaces, dedicated user (AN/TSC-85B and AN/TSC-93B only) interface, orderwire interfaces, and CESE telemetry interface (AN/TSC-100A and AN/TSC-94A only). Table D-A-A-10 lists the technical interface characteristics of the TD-1337.

(1) Satellite Side Supergroup (SG) Interface. The TD-1337 multiplexer combines the group inputs, dedicated user input (if used), and 16-Kbps DVOW input (if used) into a single supergroup. The output is an unbalanced NRZ signal that is applied to the MD-945 modem. The SG output rate can range from 16 to 4,664 Kbps in 8-Kbps increments. The SG rate is always the total of the following:

(a) Sum of active group input rates.

(b) Sixteen Kbps or 32 Kbps for dedicated user, if used.

(c) Sixteen Kbps for DVOW, if used.

(d) Eight Kbps for overhead. (This includes 2.4 Kbps for Advanced Narrowband Digital Voice Terminal (ANDVT) orderwire and 2 Kbps for DOW.)

Table D-A-A-10. TD-1337 Technical Interface Characteristics

Characteristics	Data
Satellite Side (Supergroup) Interfaces Format Rates	 Unbalanced NRZ 16-4664 Kbps in 8 Kbps increments or 4915.2 Kbps
Earth-Side Interfaces Balanced NRZ Group Format Rates	 Balanced NRZ 8, 16, 32, 64, 72 to 1152 Kbps; 4915.2 Kbps for TD-976 mode
Group Modem (CDϕ Port) Group Data Format Rates Cable length	 Conditioned diphase 72, 128, 144, 256, 288, 512, 1024, 1152 Kbps 0-2 miles for 72-576 Kbps. 0-1 mile for 1024 and 1152 Kbps
Combined Digital Orderwire Availability	Transmitted along with the CDϕ group when data rates are 256 Kbps and above
<u>Format</u> Rates CESE data Digital voice orderwire	 2 Kbps 16 Kbps

Table D-A-A-10. (Cont d)

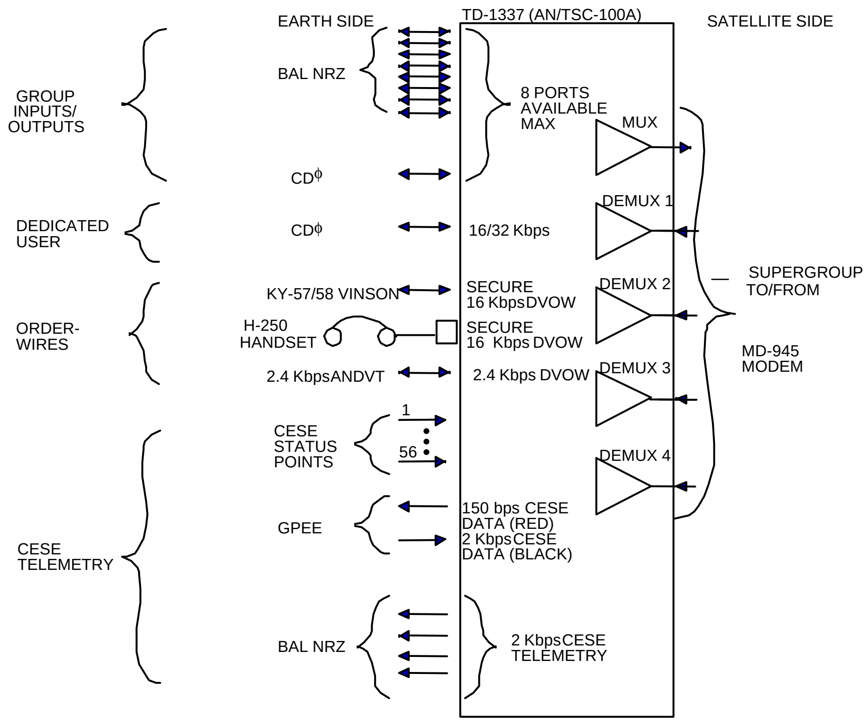
Characteristics	Data
Dedicated User Loop Modem	
Format	Conditioned diphase
Rates	16, 32 Kbps
16 Kbps DVOW	
Nonsecure mode	
Interface Device	H-250 handset
Format	Analog
Secure Mode	
Interface Device	KY-57/58
Format	Digital ± 6V
2.4 Kbps DVOW	
Interface Device	ANDVT
Format	Digital ± 6V
Rate	2.4 Kbps
CESE Functions	
Status Point Inputs	56 max
Normal condition	+ 2.4 to + 5.0 V
Fault condition	0.0 to + 0.4 V
Data to KG-84A (Red)	
Format	Digital ± 6V
Rate	150 bps
Data from KG-84A (Black)	
Format	Digital ± 6V
Rate	2 Kbps
Telemetry Output	
Format	Balanced NRZ
Rate	2 Kbps

(e) The TD-1337 models used in the AN/TSC-100A and AN/TSC-885B each contain four demultiplexers that can simultaneously demultiplex four separate and independent received supergroups. The models used in the AN/TSC-84A and AN/TSC-93A/B each contain one demultiplexer. They can demultiplex one received supergroup.

(2) Group Level Interfaces. Depending on the version, the TD-1337 group level interfaces consist of the group modem balanced NRZ interface and the group modem CDϕ interface. Figures D-A-A-4 through D-A-A-7 depict the group level interfaces and data rates provided by each of the four TD-1337 models. The maximum data rate that can be supported by an individual group port is 576 Kbps. Group rates of 1,024 Kbps and 1,152 Kbps are accommodated by autostrapping two group ports together. In this case, the group must be assigned to an odd numbered port. The next higher numbered even port then becomes unavailable for use. For example, if a group with a rate of 1,152 Kbps is assigned to port 5, port 6 would not be available for use.

(a) Group Modem Interface. The GM interface is a full-duplex balanced NRZ interface that is available in all four versions of the TD-1337 TSSP. The interface is used with digital groups from the MD-1026 GM (AN/TSC-85B and AN/TSC-100A) and/or the TD-1389 LRM (AN/TSC-85B/93B and AN/TSC-100A/94A). The (V)1 and (V)3 (AN/TSC-85B and AN/TSC-100A) models can support up to eight balanced NRZ group inputs from GMs and/or LRMS. The (V)2 model found in the AN/TSC-93B can support up to two balanced NRZ group inputs from the LRMS. The interface appears at all four ports of the (V)4 model found in the AN/TSC-94A. However, only two of the balanced NRZ group inputs may be used as the AN/TSC-94A is equipped with two LRMs. Data rates range from 8 to 1,152 Kbps.

(b) Group Modem CDϕ Interface. The GM CDϕ is a full-duplex conditioned diphase interface that is available in all four versions of the TD-1337 TSSP. The interface allows the TSSP to operate with TRI-TAC multiplexers and modems external to the satellite shelter.



GROUP INPUTS/OUTPUTS TO PORT AVAILABILTY

FORMATS / MUX/DEMUX PORTS	BAL NRZ 1/	COND.DIPHASE
1	X	X
2	X	-
3	X	X
4	X	-
5	X	X
6	X	-
7	X	-
8	X	

POSSIBLE GROUP DATA RATE (Kbps)

BAL NRZ	COND.DIPHASE
8	72
16	128
32	256
64	144
72	288
128	512
256	576
144	1024
288	1152
512	
576	
1024	
1152	

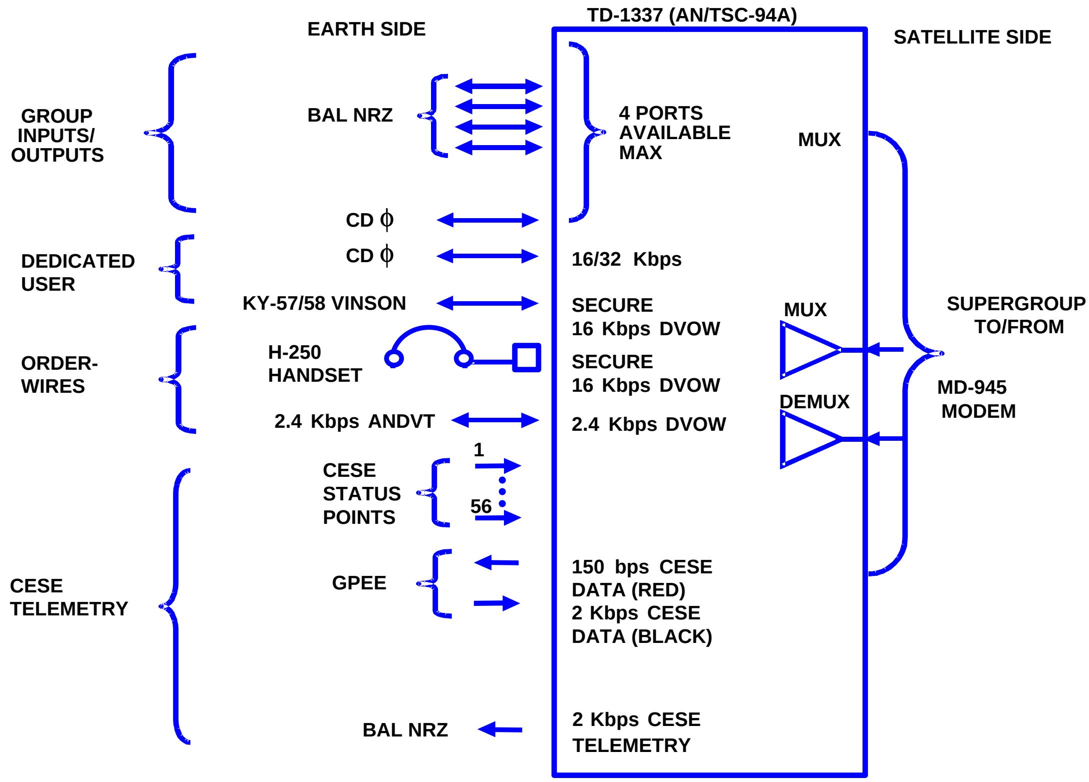
Group data rates of 1,024 Kbps and 1,152 Kbps are handled by autostrapping two ports. Group must be assigned to odd numbered port (next higher even numbered port is not available for use).

1/ Digital data rate modems MD-1026 convert the following signal formats to balanced NRZ and vice versa:

a. Conditioned Diphase (rates of 72 Kbps to 1,152 Kbps).

b. Dipulse (rates of 288 Kbps, 576 Kbps, and 1,152 Kbps).

Figure D-A-A-4. TD-1337(V)3 AN/TSC-100A Interfaces



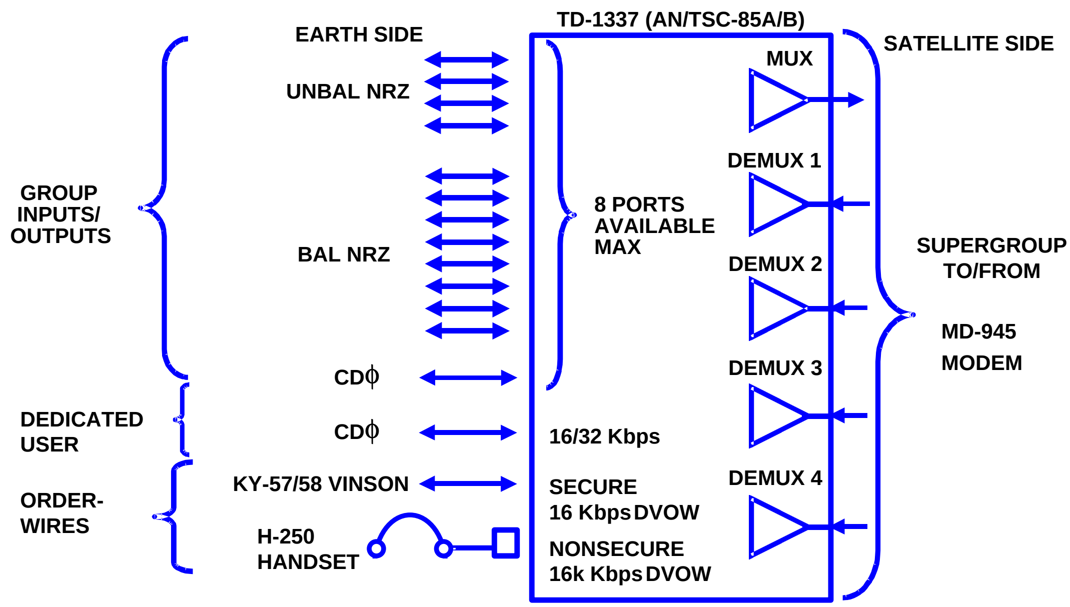
GROUP INPUTS/OUTPUTS TO PORT AVAILABILTY

FORMATS: MUX/DEMUX PORTS	BAL NRZ	COND.DIPHASE
1	X	X
2	X	-
3	X	X
4	X	-
5	X	X
6	X	-
7	X	-
8	X	

Group data rates of 1,024 Kbps and 1,152 Kbps are handled by autostrapping two ports. Group must be assigned to odd numbered port (next higher even numbered port is not available for use).

POSSIBLE GROUP DATA RATE (Kbps)	BAL NRZ	COND.DIPHASE
	8	72
	16	128
	32	144
	64	256
	72	288
	128	512
	144	576
	256	1024
	288	1152
	512	
	576	
	1024	
	1152	

Figure D-A-A-5. TD-1337(V)4 AN/TSC-94A Interfaces



GROUP INPUTS/OUTPUTS TO PORT AVAILABILTY

FORMATS — MUX/DEMUX PORTS	BAL NRZ 1/	BAL NRZ 1/ 2/	COND.DIPHASE
1	X	-	X
2	X	-	-
3	X	-	-
4	X	-	-
5	X	-	X
6	X	-	-
7	X	-	-
8	X	X	
POSSIBLE GROUP DATA RATE (Kbps)	8 16 32 64 72 128 144 256 288 512 576 1024 1152	915	72 128 144 256 288 512 576 1024 1152

1/ Digital data rate modems MD-1026 () (P)/G used to convert following signal formats to balanced NRZ and vice versa:

a. Conditioned Diphase (rates of 72 Kbps to 1,152 Kbps).

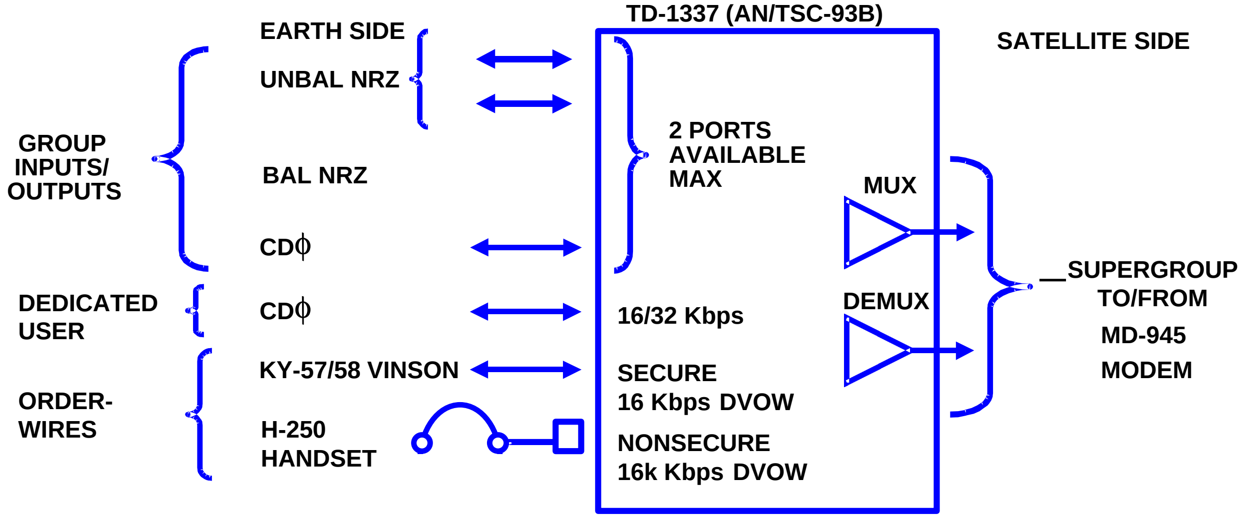
b. Dipulse (rates of 288 Kbps, 576 Kbps, and 1,152 Kbps).

c. Bipolar (rate of 4915.2) Kbps.

2/ Model is in TD-976 mode when data rate of 4,915.2 Kbps is processed. Ports 1 through 7 are not available for use in this mode.

Group data rates of 1,024 Kbps and 1,152 Kbps are handled by autostrapping two ports. Group must be assigned to odd numbered port (next higher even numbered port is not available for use).

Figure D-A-A-6. TD-1337(V)1 AN/TSC-85B Interfaces



GROUP INPUTS/OUTPUTS TO PORT AVAILABILTY

FORMATS MUX/DEMUX PORTS	BAL NRZ 1/	COND.DIPHASE
1 2		X
POSSIBLE GROUP DATA RATE (Kbps)	8 16 32 64 72 128 144 256 288 512 576 1024 1152	72 128 144 256 288 512 576 1024 1152

1/ Group data rates of 1,024 Kbps and 1,152 Kbps are handled by autostrapping two ports. When these rates are used the group input must be assigned to port 1. (Port 2 is not available for use).

Figure D-A-A-7. TD-1337(V)2 AN/TSC-93B Interfaces

Data rates can range from 72 to 1,152 Kbps. When operating at rates of 256 Kbps and above, a 32-Kbps full-duplex combined digital orderwire is available and can be transmitted along with the high-speed group data.

(c) TD-976 Interface. This interface is a full-duplex, balanced NRZ interface. It is available only in the TD-1337(V)1 model. The interface appears at port 8 and operates at a data rate of 4,915.2 Kbps. When the TSSP is configured for TD-976 operation, only port 8 is available for use.

(3) TD-1337 Group Ports. Each TD-1337 model has a certain maximum number of ports available to handle group inputs or outputs. A port is defined as the entry and exit point on the TD-1337(V)G for an active group input or output. In most cases, a given port can accommodate more than one type of interface. For example, port 1 can be configured to operate as a balanced NRZ, unbalanced NRZ, or conditioned diphase interface. The operating configuration determines which ports are active and selects the interface type to be used at each active port.

(a) The AN/TSC-100A TD-1337(V)3 has connection points for nine group inputs or outputs. From these, a maximum of eight may be selected for use. Figure D-A-A-4 defines which types of group inputs or outputs can be accommodated by each port. The possible data rates for each format are also listed.

(b) The AN/TSC-94A TD-1337(V)4 has connection points for five group inputs or outputs. From these, a maximum of two may be selected for use. Figure D-A-A-5 defines the types of group inputs or outputs that can be accommodated by each port. The possible data rates for each format are also shown.

(c) The AN/TSC-85B TD-1337 (V)1 has connection points for 13 group inputs or outputs. From these, a maximum of eight may be selected for use. Figure D-A-A-6 defines the types of group inputs or outputs that can be accommodated by each port. The possible data rates for each format are also shown.

(d) The AN/TSC-93B TD-1337(V)2 has connection points for five group inputs or outputs. From these, a maximum of two may be selected for use. Figure D-A-A-7 defines which types of group inputs or outputs can be accommodated by each port. The possible data rates for each format are also shown. As indicated by Figure D-A-A-7, Note 1, group data rates of 1,024 and 1,152 Kbps require the use of two ports.

(4) Dedicated User. A 16-Kbps or 32-Kbps dedicated user option is available. If this option is used, data from the dedicated user are included in the multiplexed output supergroup. One of the received supergroups will contain data from the dedicated user. That particular DEMUX will be selected to complete routing of data to the dedicated user.

(5) Orderwires. A 16-Kbps DVOW capability is available and has two operating modes, nonsecure and secure. Mode selection is a database entry. Earth-side interfaces are with an H-250 handset to a KY-57/58 VINSON and an external orderwire terminal on the TRI-TAC DVOW network. The external terminal could be a CNCE, an OCU-II in an AN/TTC-39 series CS, or an OCU-I in an AN/TSQ-146(V) MUX van. The DVOW interface is through the combined digital orderwire that is multiplexed on the conditioned diphase group of the TD-1337. This is available when the group data rate is 256 Kbps and above. The orderwire connectivity is shown in Table D-A-A-11. The orderwire is discussed in Appendix B to Enclosure A.

Table D-A-A-11. TD-1337 16 Kbps DVOW Connectivity

DVOW	Nonsecure	Secure
Local H-250 handset to H-250 handsets at remote TD-1337	X	--
Local KY-57 to local CNCE	--	X
Local KY-57 to KY-57 at remote TD-1337	--	X
Local KY-57 to CNCE at remote TD-1337	--	X
Local CNCE to KY-57 at remote TD-1337	--	X
Local CNCE to CNCE at remote TD-1337	--	X

(6) Telemetry. Only the AN/TSC-94A and AN/TSC-100A versions of the TD-1337 provide interfaces for reporting DOW telemetry data.

b. TD-1337 Applications. The TD-1337 allows GMF Phase II satellite terminals to operate using nonnodal point-to-point, nodal/nonnodal connectivity, mesh, and hybrid mesh/nodal/nonnodal connectivity. The following subparagraphs discuss each form of connectivity. These discussions represent typical applications. The associated drawings have been simplified in the following manner:

(1) Terminal equipment between the TD-1337 and the satellite is not shown. Terminal transmitting equipment is represented by a "T" on the diagrams. Terminal receiving equipment is represented by an "R" on the diagrams.

(2) Only group inputs and outputs are shown on the following diagrams. To aid in understanding the diagrams, each group has been assigned to an arbitrary letter designation. Thus, group A communicates with group A, B with B, and so on. The ports assigned to each group are shown by numbers.

(3) The terms nodal and nonnodal are used in the following discussions. The AN/TSC-85B and AN/TSC-100A models are nodal terminals. The AN/TSC-93B and AN/TSC-94A models are nonnodal terminals. A nodal terminal is capable of simultaneously demultiplexing received supergroups. A nonnodal terminal is capable of demultiplexing only one received supergroup.

(4) Nonnodal Point-to-Point Connectivity. This form of connectivity allows one nonnodal terminal (see Figure D-A-A-8). Inputs from groups A and B enter ports 1 and 2 of nonnodal terminal No. 1. The supergroup is processed through the terminal transmitting equipment to produce an RF output. This RF output (designated F1) is transmitted via the satellite to nonnodal terminal No. 2 where it is demultiplexed into its original composite parts. A similar process is used in the reverse direction.

(5) Nodal/Nonnodal Connectivity. This form of connectivity allows one nodal terminal to communicate with up to four nonnodal terminals. See Figure D-A-A-9 for an example of nodal/nonnodal connectivity. Inputs from eight groups, identified as A through H, are applied to input ports 1 through 8 of the nodal terminal. These eight inputs are multiplexed into a supergroup. The supergroup is processed through the terminal transmitting equipment to produce a RF output designated F1. F1 is broadcast to the four nonnodal terminals via the satellite. Each nonnodal terminal demultiplexes received supergroup F1 to obtain desired group data. Data for each group are then routed to their assigned output port.

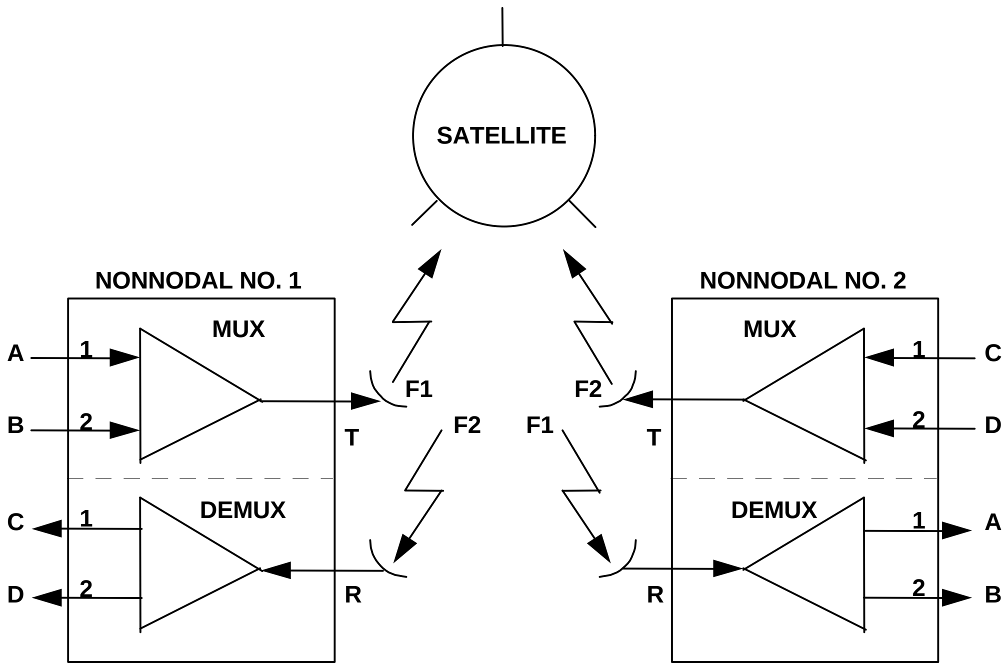


Figure D-A-A-8. TD-1337 Nonnodal Point-to-Point Connectivity

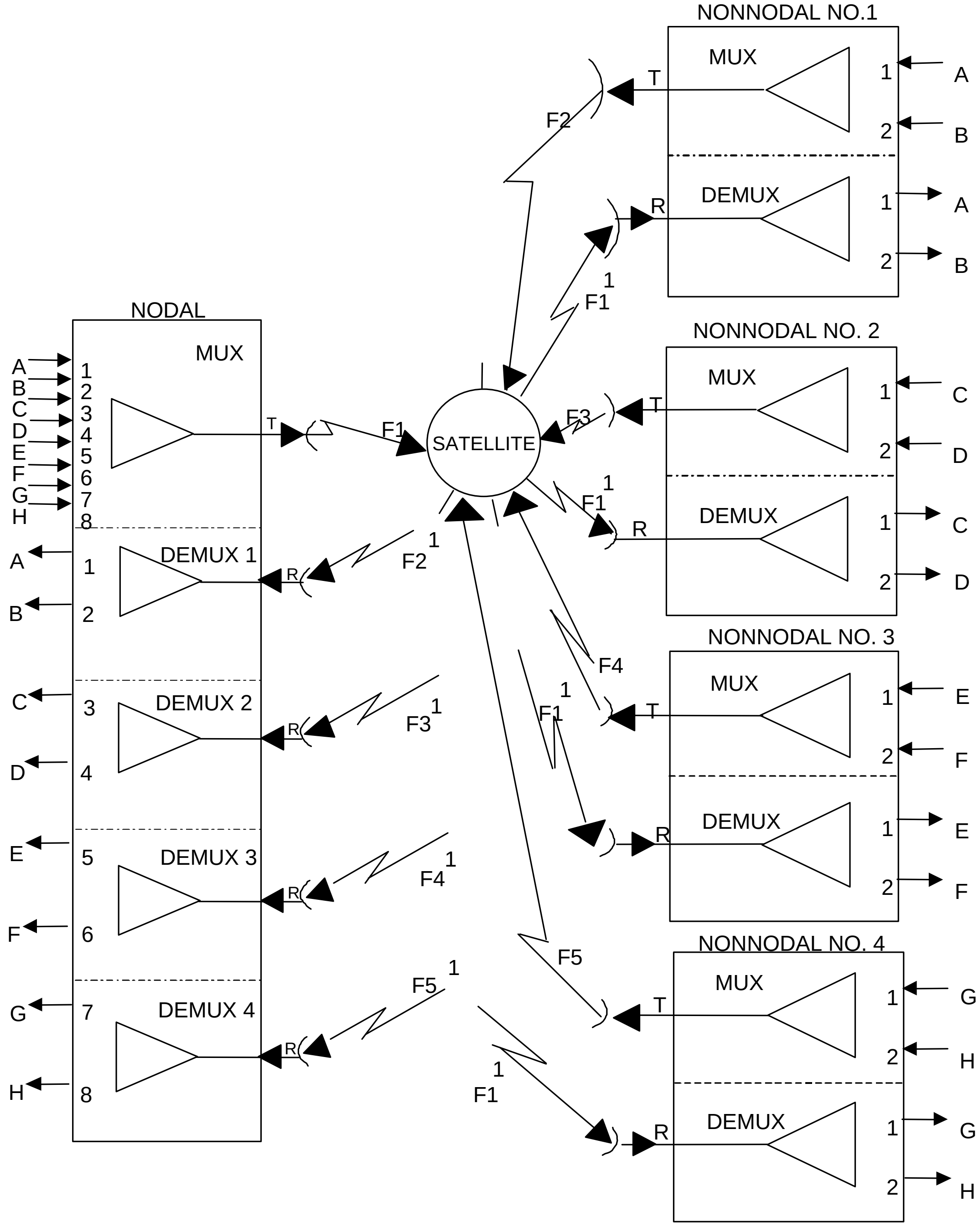


Figure D-A-A-9. TD-1337 Nodal/Nonnodal Connecticity

(a) In the return direction, each nonnodal terminal multiplexes its group inputs into an output supergroup. These four output supergroups (designated F2 through F5) are transmitted via the satellite to the nodal terminal. At the nodal terminal, each incoming supergroup is demultiplexed by a separate DEMUX. Data for each group are then routed to their assigned output port.

(b) For example, data from groups C and D enter ports 3 and 4 of the nodal terminal and becomes part of supergroup F1. In turn, nonnodal terminal No. 2 receives and demultiplexes the groups C and D, data from supergroup F1 to output ports 1 and 2 for groups C and D respectively. In the return direction, data from groups C and D are multiplexed by nonnodal terminal No. 2 to form supergroup F3. DEMUX 2 in the nodal terminal demultiplexes received supergroup F3 and routes the demultiplexed data to output ports 3 and 4. Note that:

1. The same numbered port is used to input and output data for a given group. For example, if the data from a given group enter at MUX input port 4, then return data for that group must exit at output port 4.

2. Each DEMUX has a port assignment capability controlled by operator-entered configuration data. That is, data for a given group are demultiplexed out of a received supergroup and routed to their assigned output port.

(6) Mesh Connectivity. This form of connectivity allows a nodal terminal to communicate with up to four other nodal terminals. (See Figure D-A-A-10.) In this example, each nodal terminal is shown receiving eight group inputs. Therefore, the rate of each group input is 576 Kbps or less. The nodal terminal multiplexes the group inputs together into an output supergroup. These output supergroups have been designated F1 through F5. Each output supergroup is broadcast to the other four nodal terminals via the satellite.

(a) In the return direction, each nodal terminal received four supergroups. Each incoming supergroup is demultiplexed by a separate DEMUX to obtain group data for those groups connected to that terminal. Data for each group are routed to their assigned output port.

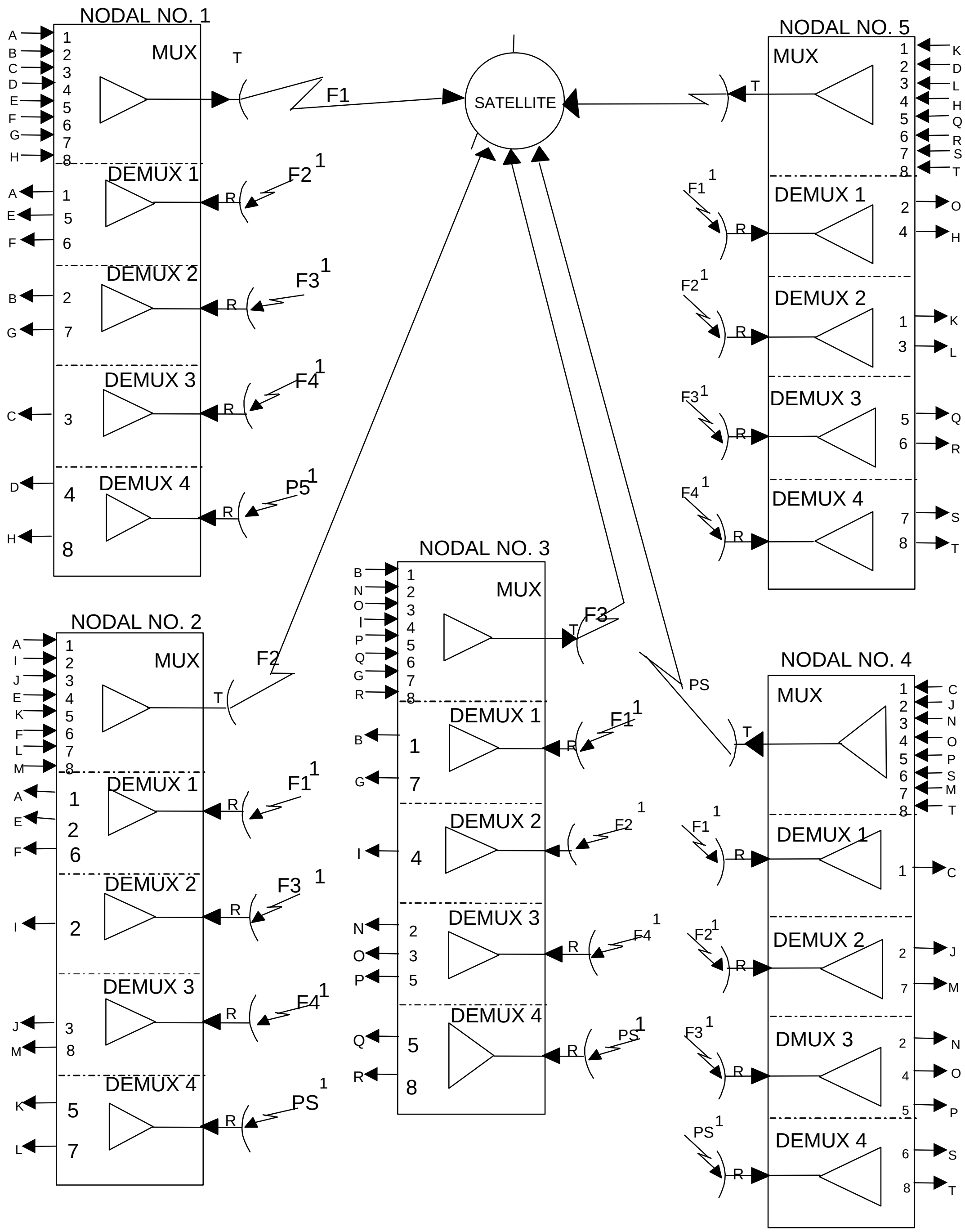


Figure D-A-A-10. TD-1337 Mesh Connectivity

(b) For example, data from group K enter input port 5 of nodal terminal No. 2 and are multiplexed into supergroup F2. DEMUX 2 of nodal terminal No. 5 demultiplexes received supergroup F2 to obtain data for group K and routes it to output port 1. Similarly, data from group K enters input port 1 of nodal terminal No. 5 and are multiplexed into supergroup F5. DEMUX 4 of nodal terminal No. 2 demultiplexes supergroup F5 to obtain data .for group K and routes it to output port 5. Note that:

1. The same numbered port is used to input and output data for a given group. For example, if data from a given group enter at MUX input port 4, then return data for that group must exit at output port 4.

2. Each DEMUX has a port assignment capability controlled by operator-entered configuration data. That is, data for a given group are demultiplexed out of a received supergroup and routed to their assigned output port.

(7) Hybrid Mesh/Nodal/Nonnodal Connectivity. This form of connectivity is a combination of mesh and nodal/nonnodal connectivities. It allows a nodal terminal to communicate with up to four other terminals that may be any combination of nodal or nonnodal terminals.

c. TD-1337 Database Considerations. The planner should ensure that sufficient data are developed to allow the operators to enter the database in the TD-1337 in the GMF terminals. Crew assignment sheets are provided in Appendix D of Enclosure A.

(1) For each TD-1337, three sections of the unit must be configured: the local MUX, the DEMUX, and the orderwire. The database entries for the local MUX basically tell the TD-1337 operator how to build up a supergroup in the transmit direction and which group from each receive supergroup it should match with the local groups to provide a two-way communications path. The data entries for the DEMUX basically tell the TD-1337 operator how the received supergroup is constructed so that the group(s) of interest in the supergroup can be found. The data entries for the orderwire identify terminal numbers and call numbers to allow calls to be completed over the orderwire system. Figure D-A-A-11 is a simplified drawing showing terminal 1, AN/TSC-85B, communicating with terminal 2, AN/TSC-93B. The database for

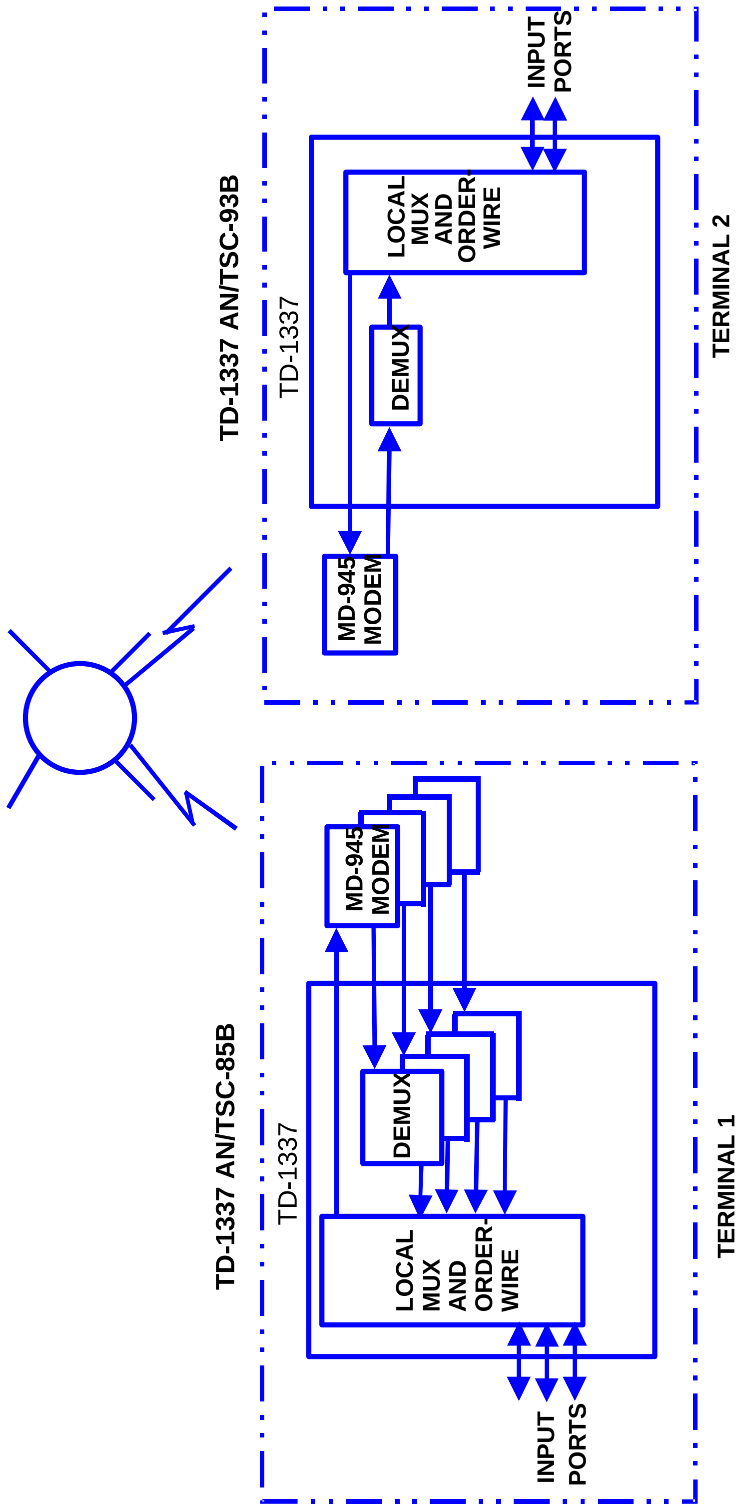


Figure D-A-A-11. Communications Using the TD-1337 the local MUX in terminal 1 must also be matched in the database for the DEMUX in terminal 2. Similarly, the database for the local MUX in terminal 2 must be matched in the DEMUX in terminal 1. This function allows each terminal to find the proper groups in the supergroup. The database entries for orderwires at both terminals must be consistent to allow proper orderwire operation as shown in Figure D-A-A-11.

(2) Several options exist for entering this data into the memories at each terminal.

(a) For the initial setup of the terminal, the three sections of the database must be entered at each terminal. To accomplish this, the terminal operators must manually enter an orderwire configuration at each terminal. This will allow the system to be initialized. A crew assignment sheet and a set of instructions for this purpose are provided in Appendix D to Enclosure A. One sheet is used for each terminal. The sheet has separate sections for entering the orderwire configuration, local MUX configuration, and remote MUX minimum configuration. It also has space to enter the local terminal location and the location of the distant terminals associated with the MUXs and DEMUXs. Entering the terminal locations on the sheet will help prevent errors in developing the database. Once communications have been established in the network, several options exist for reconfiguring the system.

(b) One method is to have all terminal operators enter a new configuration (local MUX, orderwire, and remote MUX) at their terminals. Normally, all operators would enter the new configuration in their TD-1337 offline memory, and then switch to the new configuration at the predesignated time.

(c) It is also possible for a nodal terminal operator to input a remote MUX configuration for downloading (see Appendix D to Enclosure A) into the terminal and transmit it to one of the nonnodal terminals by using a "down load to nonnodal" command. This will pass all the data necessary for the reconfiguration of the local MUX and DEMUX of the nonnodal terminal. (The operator at the nonnodal terminal must take action to place the new configuration online. The download does not automatically configure the system.)

(d) It is also possible for any terminal (nodal or nonnodal) operator to enter a new local MUX configuration into the terminal and perform a "download local configuration" to all terminals receiving the supercarrier. Downloading will pass all the data necessary for the reconfiguration of the distant terminal DEMUX. (These data will be for only the one DEMUX at the distant terminal that is used to decode the super-carrier of the transmitting terminal.) The operator at the receiving terminal will have to take action to place the new configuration online.

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ANNEX B TO APPENDIX A TO ENCLOSURE D

AN/TSC-93B(V) SATELLITE TERMINALS

1. Introduction. The AN/TSC-93B(V) NNT is a full-duplex, satellite communications terminal. It operates on a point-to-point basis, either with another NNT such as an AN/TSC-94A(V) or an AN/TSC-93B(V)1, or as part of a nodal configuration with terminals such as the AN/TSC-85B(V) or the AN/TSC-100A(V). The AN/TSC-93B(V) simultaneously transmits and receives a single carrier. The principal characteristics of the AN/TSC-93B(V) are given in Table D-A-B-1. There are two versions of the AN/TSC-93B, each one providing different capabilities. The (V)1 version is supplied with ring converters and echo suppressors. It is used by the Army, Marine Corps, and JCSE. The (V)2 contains a frequency standard, secure voice terminal, and teletype supported by a GPEE device. It is used only in support of the NATO Air Base System.

Table D-A-B-1. AN/TSC-93B(V)1 Technical Characteristics

Characteristics	Value
Terminal	
Frequency (GHz)	
Transmit	7.9-8.4
Receive	7.25-7.75
Antenna	
Reflector	8 ft parabolic
Power Output (Watts)	500 (nominal)

Table D-A-B-1. (Cont'd)

Characteristics	Value
User Interfaces (Individual)	
Analog	300-3400 Hz bandwidth (CVSD interface with LRM)
Digital	16/32 Kbps CDϕ digital voice (LRM) 0-56 Kbps CDϕ digital data (LRM) 16/32 Kbps CDϕ (Dedicated user to TSSP) 72,128,144,256 Kbps CDϕ (via LRM) 32 Kbps CDϕ (direct to AJCM)
FSK	0-1.2 Kbps (LRM)
IF (MHz)	70 (bypasses multiplex and modem groups within shelter)
User Interfaces (Group) (Kbps)	
CDϕ	≤ 1,152
Bipolar	4915.2
Transmitter Units	
Power Amplifier	
Frequency Range (GHz)	7.9-8.4
Bandwidth (MHz)	40
Power Output	630 Watts (maximum)
Upconverter	
Input Frequency	70 MHz ± 20 MHz
Frequency Selection	0.1 MHz steps

Table D-A-B-1. (Cont'd)

Characteristics	Value
Receiver Units	
LNA Assembly	
Frequency Range (GHz)	7.25-7.75 GHz
Bandwidth (MHz)	500 MHz
Gain (dB)	39-43 dB
Downconverter	
Input Frequency (GHz)	7.25-7.75
Frequency Selection	0.1 MHz
IF Output Frequency	70 MHz, ± 20 MHz

2. AN/TSC-93B(V)1 Functional Description. A functional block diagram of the AN/TSC-93B(V)1 is shown in Figure D-A-B-1. A brief description of the operation of the terminal is given below.

a. The number and types of external circuits that the AN/TSC-93B(V)1 can interface with are determined by the number of LRMs contained within the terminal and by the number and type of LRM user interface cards provided. The Army terminals contain two LRMs and are provided with a total of 12 digital, 13 CVSD, and 6 FSK interface cards. The Marine Corps and JCSE terminals contain 3 LRMs and are provided with a total of 18 digital, 25 CVSD, and 6 FSK (not the Marine Corps) cards. The characteristics of the LRM also limit the number and types of circuits supportable because its maximum passable bandwidth is 256 Kbps. The loop circuits may be digital, analog, or FSK. The terminal can accommodate up to 12 two-wire circuits with echo suppression and ring conversion.

b. Each LRM may also accept a CDϕ group in lieu of individual circuits. These groups are limited to a maximum size of either 32 Kbps or 256 Kbps. This maximum rate is determined by the equipment within the terminal that is to support the group. If the group is to be supported by the TSSP and encrypted by the KG-94, 256 Kbps is the maximum rate supportable. If the group is destined to be supported by the AJCM, 32 Kbps is the maximum rate supportable.

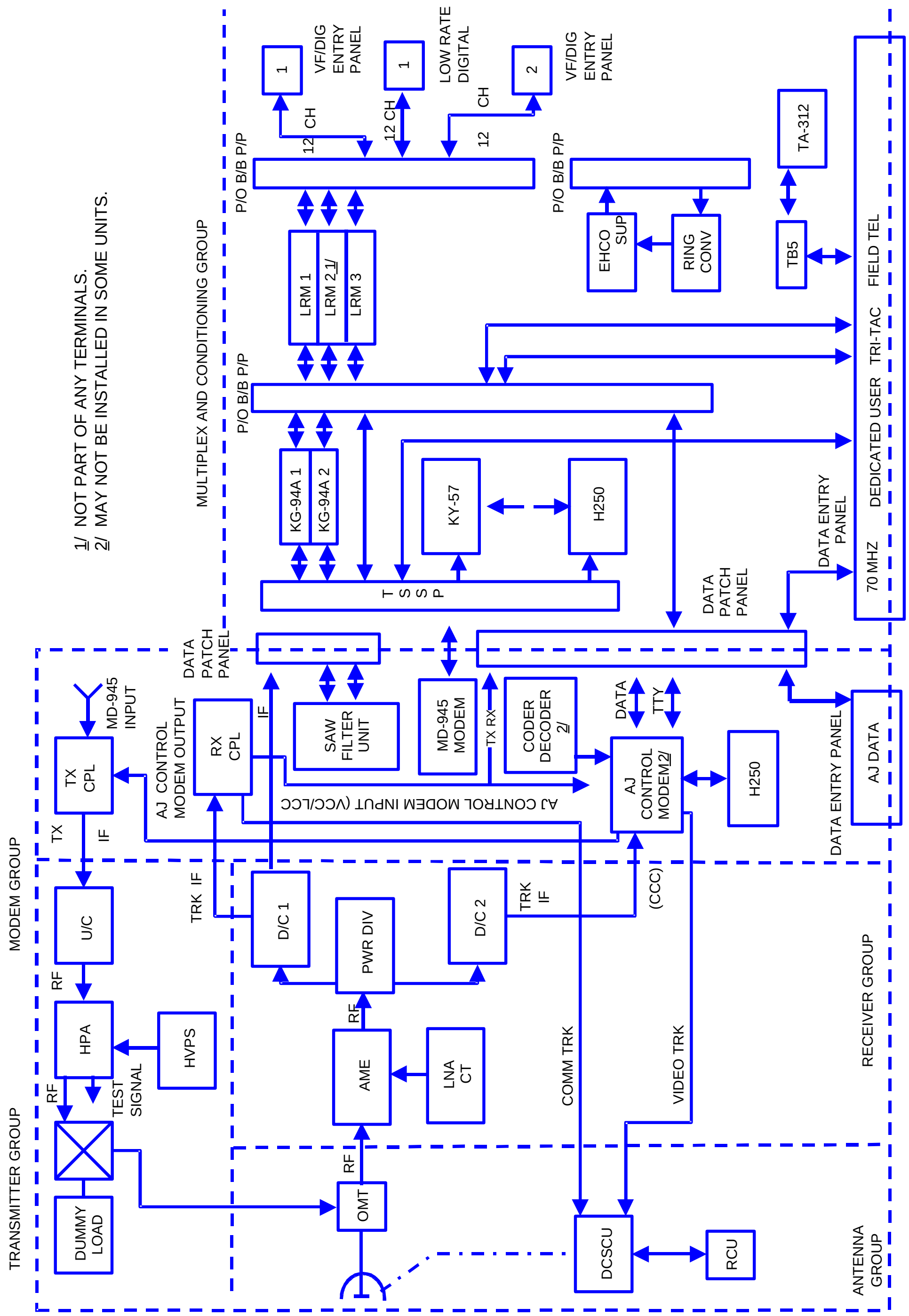

Figure D-A-B-1. AN/TSC-93B(V) 1 Functional Block Diagram

c. On the equipment side, composite outputs of up to two LRMs may interface with the TD-1337 TSSP via the KG-94A TEDs. The TSSP combines the outputs of the TEDs and, if applicable, a TRI-TAC group. If a TRI-TAC group is to interface directly with the TSSP, it must occupy the first port on the TSSP and be at a rate not to exceed 1,152 Kbps. If the rate is higher than 576 Kbps, only the TRI-TAC group can be supported because the group effectively occupies both port 1 and 2 of the TSSP. The TSSP, in conjunction with the H-250 handset, provides an over-the-satellite 16-Kbps DVOW. This DVOW may be secured via the TSEC/KY-57 VINSON or may be nonsecure. The supergroup side of the TSSP interfaces with the MD-945.

d. The MD-945 Digital Data Modem employs either BPSK or QPSK modulation. Its output is a 70 MHz intermediate frequency (IF). The surface acoustic wave (SAW) filter compresses the IF received from the MD-945 and eliminates unwanted sidelobes, producing a clean 70-MHz IF with a bandwidth of 40 MHz.

e. When supplied, the AJCM group provides the capability for a single, full-duplex, antijam communications circuit between satellite terminals. This circuit supports data rates from 75 bps to 32 Kbps. A second circuit, identified as a critical control circuit (CCC), is provided between the AN/TSC-93B(V) and the network control terminal (NCT). The CCC is a 75-bps digital circuit which provides control signals to the processor within the NNT's MD-1131/G and submits status over the satellite to the NCT. This equipment group is discussed in greater detail in subparagraph 7b below.

f. The transmit coupler sums the 70-MHz transmit signals from the M-945 and, if supplied, the MD-1131/G. The resultant 70-MHz IF is presented to the U/C. The output of the upconverter is between 7.9 and 8.4 GHz, selectable in 100-kHz increments. The HPA accepts the upconverted signal and produces an output signal at up to 57.6 dBm (575 watts) with a bandwidth of 40 MHz.

g. The antenna group consists of an antenna, an orthogonal mode transducer (OMT), and an antenna pointing equipment group. The OMT is a directional coupler that accepts transmit signals from the HPA and passes them to the antenna for transmission. It also accepts RF signals from the antenna and passes them to the antenna-mounted electronics

(AME) equipment within the receiver group. The antenna pointing equipment consists of a dual-capability servo control unit (DCSCU) that produces the drive voltages required to point the antenna. The pointing voltages are derived from input signals from the tracking downconverter (D/C) via either the receive coupler or, if available, from the AJ Modem. A second input to the DCSCU is from the remote control unit (RCU). The RCU provides the man-machine interface between an individual manually pointing the antenna and the DCSCU.

h. The AME consists of a directional coupler, a wideband preselector, and a low-noise amplifier (LNA). The directional coupler accepts the received signal from the antenna group or a test signal that attenuates it by 20 dBm. Either of these signals is then passed to the wideband preselector that selects a 500-MHz wide signal between 7.25 and 7.75 GHz. The resultant signal is then passed to the LNA, which provides amplification.

i. The received signal, after processing by the AME, is split by the power divider and passed to the two D/C. Normally, one D/C is employed as the communications D/C while the second D/C is employed in support of the AJ system. The outputs of both D/Cs are sent to the modem group. The receive signals are acted on by the components within the modem group and the multiplex and conditioning group in a manner opposite that employed in the transmit path of the same type signal.

3. <u>AN/TSC-93B(V) Physical Description</u>. The terminal is housed in a S-250 shelter. Inside the shelter, roadside equipment racks contain the radio subsystem (RSS), curbside equipment racks contain the communications subsystem (CSS), and the front wall panel contains the environmental control unit (ECU). On the outside shelter wall, there are sealed entry panels to accommodate signal and power cables. The shelter may be mounted on an M-720 transporter or carried in an M-885 or M-561 truck. The antenna pallet transit frame can be transported on a M-101 trailer. Table D-A-B-2 lists major end items.

4. <u>Antenna</u>. The AN/TSC-93B(V)1 normally uses an 8-foot parabolic antenna, AS-3036/TSC. This is a right-hand circular polarized transmit and left-hand circular polarized receive antenna system. This system has a receive gain of 42.8 dB and a transmit gain of 43.8 dB. The

AN/TSC-93B(V)2 uses the 20-foot parabolic quick reaction satellite antenna group, OE-361.

Table D-A-B-2. AN/TSC-93B(V)1 Major Equipment Items

Equipment Item	Quantity	
	(V)1	(V)2
C-10273, Antenna Control Unit	1	1
AM-6701, HPA	1	1
CV-3198, Upconverter	1	1
CV-3201, Downconverter	2	2
MD-945, Digital Data Modem	1	1
TD-1337, TSSP	2	1
MD-1026, GM	1	1
MX-9635, Echo Suppressor	1	0
C-11110, LNA Control/Translator	1	1
AM-6700, LNA	2	1
O-1677, Synthesizer	3	
OE-361, Antenna	--	1
AS-3036, Antenna	1	--
Antenna Remote Control Unit	1	
CV-1548, Converter	1	0
KG-94A, TED	2	2
TD-1389, LRM	2 or 3 1/	3
MD-1131, AJ Control Modem 2/	1	1
MD-1132, AJ Communications Unit 2/	1	1
OX-63/G, Four Channel TRANSEC 2/	1	1
TA-838, Telephone Set	0	1
AN/UGC-129, Teletypewriter	0	1
KY-57 3/	1	1

1/ Army terminals contain two, Marine Corps and JCSE contain three.
2/ May not be installed in some terminals.
3/ Supplied by using units.

5. Multiplex and Conditioning Group. The multiplex and conditioning group provides the interface between external analog and digital signals and the modem group.

a. Conditioning Equipment. The terminal contains analog conditioning equipment that consists of one CV-1548 two-wire/four-wire converter and one MX-9635/TSC echo suppressor. Each of these conditioning equipment may support up to 12 individual circuits. No circuit conditioning is provided for four-wire analog or digital circuits.

b. TD-1389 Low Rate Multiplexer. The LRM is an adaptive time division multiplexer (ATDM). It can multiplex up to 12 full-duplex digital, analog, or PSK signals, depending upon the user interface cards provided. It will accommodate input data rates from 37.5 bps to 56 Kbps, depending on the application. The composite output rate is the sum of the input rates plus overhead and cannot exceed 256 Kbps. The LRM can so accept a conditioned diphase group input at 256 Kbps or less. The LRM's characteristics and operation are covered in greater detail in Annex A.

c. TSEC/KG-94A Trunk Encryption Device. The TED performs full-duplex, digital data encryption of transmit group signals from the LRMs and decrypts group signals received from the TD-1337 TSSP.

d. TD-1337(V)2/G Tactical Satellite Signal Processor. The TSSP combines inputs from the LRM, TED strings, and an external CDϕ group modem, 16-Kbps VINSON encrypted or nonencrypted digital voice orderwire, and a dedicated 16- or 32-Kbps conditioned diphase user. Table D-A-B-3 lists the allowable combinations of these inputs and their resulting output rates. It should be noted that the version of the TSSP employed in the AN/TSC-93B(V) does not provide data orderwire capabilities. Additional characteristics and setup of the TSSP are covered in greater detail in Annex A.

6. Interfaces

a. Group Interface

(1) Conditioned Diphase. The data entry signal panel provides CX-11230 cable interfaces for up to two CDϕ groups. If either of these groups require encryption by the KG-94A TEDs located within the

terminal, the group must be patched to LRM 1 or 2. The LRM converts the CDϕ signal to an NRZ signal and passes it to the TED. The required use of LRMs limits either of these groups to a maximum rate of 256 Kbps and precludes the accommodation of individual circuit interfaces.

Table D-A-B-3. TD-1337(V)2/G Input/Output Configurations

Port A (Kbps)	Port B (Kbps)	Supergroup Output (Kbps) 1/
LRM @ 9.6-256	-	17.2-264
LRM @ 9.6-256	LRM @ 9.6-256	27.2-520
CDϕ @ 72-576	-	80-584
CDϕ @ 72-576	LRM @ 9.6-256	89.6-840
CDϕ @ 72-576	CDϕ 72-576	152-1160
CDϕ @ 1,024-1152	-	1032-1160

1/ Supergroup output includes 8 Kbps of overhead. If the dedicated user circuit is provided, add 16 or 32 Kbps as appropriate. If the O/W is used, add 16 Kbps.

(a) If encryption is accomplished outside the shelter or if encryption is not required and no individual circuit interfaces require service, two CDϕ groups are supportable. One group interfaces directly to port one of the TD-1337 TSSP at data rates up to and including 576 Kbps. The second group, at a data rate of up to 256 Kbps, interfaces with one of the LRMs. This group is passed on to port 2 of the TSSP.

(b) A third option is to interface a single CDϕ group at rates up to 1,152 Kbps to port one of the TSSP. For rates above 576 Kbps, this option precludes the use of either LRM one or two.

(2) 70 MHz Intermediate Frequency. The data entry panel provides an interface for a single, external 70-Mhz IF signal. This signal interfaces with the transmit coupler via the data patch panel. Its use precludes the use of the MD-945 modem and any of the inputs to the modem previously discussed.

b. Single Channel Interfaces

(1) Dedicated User Port. A single 16- or 32-Kbps CDϕ Dedicated User is provided access to the terminal via the data entry panel, through the baseband patch panel to the TD-1337, TSSP.

(2) Analog. Because of the number of LRMs supplied with the Army terminals (2), and to the Marine Corps and JCSE terminals (3), the number of analog circuits supportable differs. With one LRM in support of AJCM operations, Army terminals can support up to 12 analog circuits even though they are supplied with 13 CVSD cards. Although the Marine Corps and JCSE terminals are provided with 25 CVSD cards, the two LRM/KG-94A strings can support a total of 24 analog circuits; only 12 may be two-wire circuits.

(3) Digital. The Army terminals may support up to 12 digital circuits, while the Marine Corps and JCSE terminals may support up to 18.

(4) FSK. In both the Army and the JCSE type terminals, six FSK circuit interface cards are provided. These interfaces are associated with the low-rate entry panel and LRM #3.

7. Modem Group. The modem group is composed of a transmit coupler and the SAW filter unit. These three items are discussed in paragraph 2 above. Also included in this group are the M-945 modem and the AJCM with its associated coder/decoder group and H-250 headset. These items are also discussed in paragraph 2 above but will be addressed in greater detail below.

a. MD-945 Data Modem

(1) This modem is capable of supporting NRZ transmit and receive data at rates between 16 and 4,999 Kbps. Data in the modem are always differentially coded. When the CODED/UNCODED switch is in the CODED position, the data are also convolutionally encoded. Convolutional coding provides forward error correction and thus allows data to be passed over systems with higher bit error rates than would be possible without its use. Differential coding is a form of signal

conditioning that does not provide forward error correction. The use of convolutional coding increases the system bandwidth required to pass mission data.

(2) The modem operates in either the BPSK or the QPSK mode. In the BPSK mode, the phase of the 70-MHz output signal is shifted in phase between 0 and 180 degrees with respect to the input signal. In the QPSK mode, the 70-MHz signal is shifted in phase through four phases of 0, 90, 180, and 270 degrees. The employment of QPSK has the effect of reducing the mission bandwidth by one-half. The operating mode is determined by the transmit data rate and the available bandwidth. For input data rates between 100 Kbps and 2,499 Kbps, only the QPSK mode is available and the XMT Q-B Switch on the modem is disabled. Table D-A-B-4 presents the nominal bandwidth required for each of the possible combinations of coding and modulation schemes.

Table D-A-B-4. Modulation and Coding Effects on Bandwidth

Modulation	Coding	Input Data Rate	Nominal Bandwidth
BPSK	Uncoded	R	2R
BPSK	Coded	2R	4R
QPSK	Uncoded	R/2	R
QPSK	Coded	R	2R

b. <u>AJCM Group</u>. The AJCM group is made up of the MD-1131/G Digital Data Modem and the OX-63/G Coder/Decoder transmission security equipment. The digital data modem provides distribution of the 5-MHz reference frequency. The 5-MHz is obtained from either the upconverter or, if available, from a timing standard. The modem also provides two digital data communications circuits or one digital data and one voice circuit. Each of these circuits is discussed in detail below. (See Annex F for a detailed discussion of the AJCM.)

(1) <u>Critical Control Circuit</u>. The CCC is a 75-bps circuit that provides a means for network command and control. The circuit is operated in the broadcast mode between the network control terminal (NCT) and the AN/TSC-93B(V)1 and other network terminals. The NCT establishes the network by acquiring a beacon signal that it uses for

frequency and synchronization purposes. The NCT then activates each individual NT control modem. Optimal network parameters are maintained by the NCT monitoring the satellite signal frequency and amplitude and by using these data to compute the conditions necessary to maintain the system at an optimum level. Automatic control of the network is maintained by command signals being transmitted to each control modem in the system via the CCC. Responses to these commands from the NT results in such activities as turning on the NT control modem modulator or returning status information in response to a polling request also via the CCC.

(2) Link Communications Circuit. The LCC is a digital, 75-bps to 32-Kbps, data circuit between NTs. Normally, the data carried over this circuit are multiplexed by LRM #3 and enter the NT as FSK signals via the low rate entry panel. The data rate of the LCC circuit may be changed as stress conditions change. The terminal operator at either end of a link that has been determined to be under stress will be directed by the satellite controller to reduce the data rate of the LCC. The terminal operator who has been directed to reduce the data rate of the LCC will input the new data rate into the AJCM interface control unit and initiate the data rate change as described in the AJCM operator's manual. The initiating NT commands to the distant terminal and the handshaking required to effect the data rate change are accomplished via the LCC. The distant NT operator has up to 3 seconds to confirm acknowledgment of the data-rate change and, once acknowledged, up to 30 seconds to accomplish the required terminal reconfiguration. If data resynchronization is not accomplished within 30 seconds, the data-rate of the LCC automatically falls to 75 bps (AUTO 75) and the data-rate change process is repeated. During data-rate change periods, the LCC is not available for user traffic. In a jamming environment, the LCC may be the only data communications capability that is available between NT users.

(a) An optional digital AJ user signal interface may be supported in lieu of the one provided through the LRM. User signals access the shelter at the DATA/SIGNAL entry panel located on the roadside of the shelter via the six push posts identified as the AJ DATA group. These signals are balanced or unbalanced NRZ or teletype signals. Selection of either the baseband signals (from the LRM) or the

AJ data signals in accomplished at the modem patch panel, data patching group.

(b) Voice Communications Circuit. The VCC is a 16-Kbps digital voice orderwire circuit between NTs. This circuit is used in nonstressed environments. Operator access to the VCC is via an H-250 handset that plugs directly into the control modem front panel. While VCC calls are in process, the LCC circuit is not available for use. The VCC circuit is not extendable outside the NT. The circuit is available only between NTs that have direct over the spacecraft contact such as between two AN/TSC-93Bs or between an AN/TSC-93B and an AN/TSC-85B in a hub-spoke configuration. With multiple AN/TSC-93Bs (up to 4) operating with an AN/TSC-85B, any AN/TSC-93B can capture the AN/TSC-85B VCC, but the AN/TSC-85B can communicate with only one AN/TSC-93B at any given time.

8. Patching. Patch panels are provided in the AN/TSC-93B(V)1 to isolate equipment groups and to facilitate the interconnection of system components to form various configurations. The four patch panels within the terminal are the baseband patch panel, the data patch panel, the modem patch panel, and the down converter input patch panel. The data patch panel is housed within the modem patch panel assembly.

a. Baseband Patch Panel. The B/B P/P accommodates signals to and from the VF/DIG entry panel, the low rate entry panel, and the data entry panel. Within the terminal, the B/B P/P accommodates signal flow between circuit conditioning equipment, LRMs, KG-94As, and the TSSP. Patch (1) provides echo suppression and ring conversion to a two-wire analog user. Patch (2) extends a multiplexed TRI-TAC group from the TRI-TAC input on the data entry panel to the CDϕ group input on the TSSP. Patch (3) extends a CDϕ group to LRM 1 from the spare MUX TRI-TAC appearance on the data entry panel. If patch (3) is made, LRM 1 is employed as a group multiplexer. If LRM 3 is not required to support AJ operations and the terminal is an Army terminal, LRM 3 could be employed as LRM 2.

b. Modem Patch Panel. The modem patch panel is separated into eight separate sections. The sections are the EXT 70-MHz section, the

5-MHz section, the C/KT ATTENUATOR section, RECEIVE directional coupler section, the TRANSMIT directional coupler section, a RECEIVE FILTER section, a TRANSMIT FILTER section, and a POWER section. The power section provides power and protection to the other components in the modem patch panel.

(1) The EXT 70-MHz section of the patch panel provides access to the externally generated 70-MHz baseband signal. Patches between the EXT 70-MHz section and TRANSMIT and RECEIVE filters accommodate the use of the external baseband in lieu of the internally (MD-945) generated baseband signals. The 5-MHz section of the modem patch panel provides access to the 5-MHz reference signal distribution as it is supported by the AJCM. The AJCM does not produce a reference signal, but splits a signal received directly from the upconverter, or from the frequency standard, into three outputs. These outputs are patched to the D/Cs and to the LNA/CONTROL TRANSLATOR. The converters use the 5 MHz reference signal in lieu of internally generated signals. The LNA/CONTROL TRANSLATOR (TEST XLTR) patch allows for the patching of either the 5-MHz from the upconverter or from the AJCM to the test translator.

(2) The C/kT section of the modem P/P provides inline attenuation of 70-MHz signals for use in test configurations and to calibrate the test translator.

(3) The RECEIVE directional coupler accepts the TRK IF output (70-MHz IF) from the communications D/C, splits it, and provides a negative 10-dB output to the AJCM COMM IF IN port. The second output is provided to the DCSCU.

(4) The RECEIVE and TRANSMIT filters provide sharp cutoffs to the receive and transmit IF signals. Each of these filters is tuned by the use of the bandwidth switch to the width of the baseband.

(5) The TRANSMIT directional coupler accepts a 70-MHz IF signal input from the AJCM IF OUT port and from the IF OUT port of the TRANSMIT filter. The output of the coupler, the sum of the inputs, is provided to the upconverter.

c. <u>Data Patch Panel</u>. The DPP accommodates signal flow between the AJCM and B/B P/P for connectivity to LRM #3. The second option provided is for the connection from the data entry appearance to either the UNBALANCED or TTY interface on the AJCM. Only one AT BALANCED, UNBALANCED, or TTY patch may be accommodated at any given time because the three appearances are physically the same input to the AJCM.

d. <u>Downconverter Input Patch Panel (D/C INPUT P/P)</u>. Although identified as a patch panel, the D/C INPUT P/P is primarily a power divider that accepts a single SHF input from the AM-7135/G low-noise amplifier, splits it, and presents two outputs for patching to the two downconverters.

9. <u>Signal Entry</u>

a. Two sets of signal entry panels accommodate user interfaces. These signal entry panels are numbered 1 and 2. Panel 1 contains two U-187U/G (26 pair) cable connectors labeled VF/DIG and LOW RATE DIG, respectively. The VF/DIG patches are wired through to LRM #1 while the LOW RATE DIG patches are wired through to LRM #2. Signal entry panel #2 contains a single U-187U/G connector labeled VF/DIG and is through wired to LRM #3.

b. The MUX/TRI-TAC and SPARE appearances are extended to the B/B P/P. The AJ DATA field wire push pins are extended to the Data P/P where they appear as DATA ENTRY. The DED USER push pins are extended directly to the TSSP. The four SPARE push pins are extended to terminal board 5. The FLD TEL push pins are also extended to terminal board 5 and to the telephone within the shelter. The CBR appearance is extended through terminal board 5 to the CBR pressure switch.

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ANNEX C TO APPENDIX A TO ENCLOSURE D

AN/TSC-94A SATELLITE TERMINAL

1. AN/TSC-94A(V) Nonnodal Terminal (NNT). The AN/TSC-94A is a full-duplex point-to-point satellite communications terminal. It operates on a point-to-point basis, either with another nonnodal terminal such as an AN/TSC-93B or AN/TSC-94A, or as part of a nodal configuration with an AN/TSC-85B or AN/TSC-100A. The principal characteristics of the AN/TSC-94A are given in Table D-A-C-1. There are two versions of the AN/TSC-94A: the (V)1 and (V)2.

Table D-A-C-1. AN/TSC-94A Characteristics

Characteristic	Data
Transmit Group	
Frequency Range (GHz)	7.9-8.4
Frequency Selection	100 kHz steps
Power Output @ 8' antenna flange	
Coherently Combined	59.5 (890 Watts)
Combiner Bypassed	57 (500 Watts)
Receive Group	
Frequency Range (GHz)	7.25-7.75
Frequency Selection	100 kHz steps
G/T (8 foot antenna)	18 dB/°K
Antenna-8 foot	
Gain-transmit (dBi)	43.5
Gain-receive (dBi)	42.5
Polarization-transmit	Right-hand circular
Polarization-receive	Left-hand circular
Beamwidth-transmit (degrees)	0.95°
Beamwidth-receive (degrees)	1.10°

2. AN/TSC-94A Functional Description. A functional block diagram is shown in Figure D-A-C-1. A brief description of the operation of the terminal is given below.

a. The AN/TSC-94A provides interfaces for both individual user channels and a single TRI-TAC CDϕ group. The number of individual channels that can be supported by the terminal depends on the number of TD-1389 LRMs contained in the terminal. The AN/TSC-94A(V)1 is equipped with 2 LRMs and

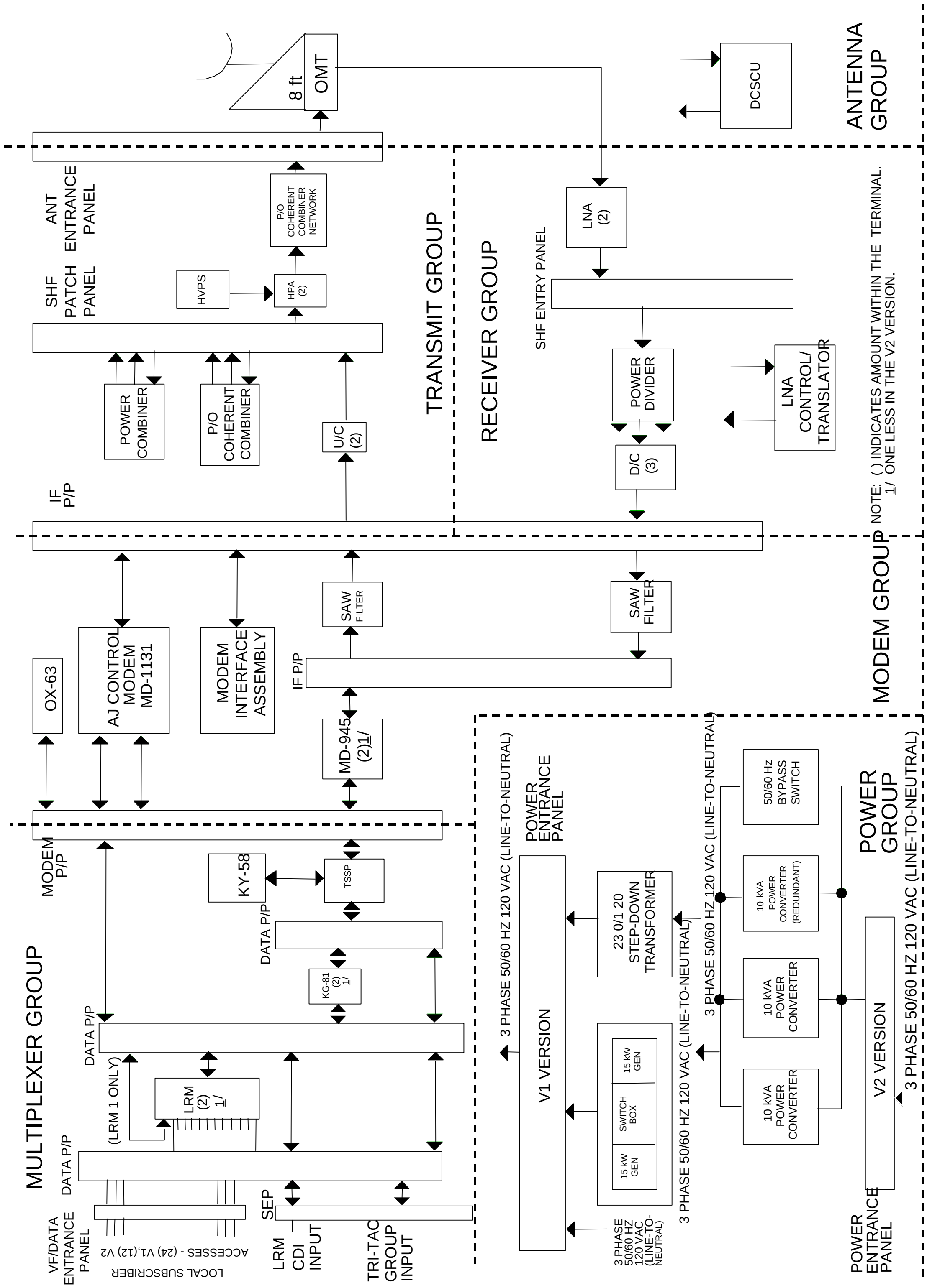

Figure D-A-C-1. AN/TSC-94A Functional Block Diagram can support up to 24 individual user channels. The AN/TSC-94(V)2 has a single LRM and can support up to 12 individual channels. The number and type of individual channel interfaces that can be supported by the LRM depend on the its line interface card complement. Air Force LRMs are currently configured with three digital cards, three FSK cards, and six CVSD cards. The LRM is also capable of interfacing with a single TRI-TAC group in lieu of individual user circuits. The maximum group rate is 256 Kbps. The group output of the LRM may be connected to either the TD-1337 TSSP (via the KG-81 TED) or to the AJCM.

b. The AN/TSC-94A version of the TSSP can support a maximum of two group inputs. It interfaces with the composite group output of the LRM and/or an external TRI-TAC CDϕ group direct connected from the SEP. The external TRI-TAC group must be connected to port 1 of the TSSP and cannot exceed a group rate of 1,152 Kbps.

c. The maximum group rate that can be supported by a single TSSP port is 576 Kbps. In order to support a group rate of 1,152 Kbps, two TSSP ports must be strapped together. If the terminal is required to support both individual user channels via the LRM and an external TRI-TAC group, the group rate of the TRI-TAC group cannot exceed 576 Kbps. The composite group output of the TSSP interfaces with the MD-945 digital data modem.

d. The MD-945 can employ either BPSK or QPSK modulation. It accepts the unbalanced NRZ composite supergroup output from the TSSP and outputs a BPSK or QPSK modulation 70 MHz IF signal. The 70-MHz IF signal is sent to the SAW filters that compress the bandwidth and eliminate unwanted sidelobes. The output of the SAW filters is a clean 70-MHz IF signal with a bandwidth of 40 MHz.

e. The NNT AJCM consists of the M-1131 control modem and the OX-63 coder group. It provides the capability for full duplex antijam data communications at data rates from 75 bps to 32 Kbps between GMF satellite terminals. The AJCM also provides a 75 bps CCC between the AN/TSC-94A and the NCT. The CCC is used by the NCT to control the AJ protected network.

f. The modem interface assembly contained in the IF patch panel takes the 70-MHz IF outputs of the MD-945 modem and the AJCM and combines them into a single 70-MHz signal. The combined 70-MHz IF signal is then provided to a single upconverter. All modem interface assembly input/output ports appear on the IF patch panel.

g. The upconverter accepts a 70-MHz IF signal from the modem group and upconverts it to a SHF frequency in the 7.9- to 8.4-GHz range, selectable in 100-kHz increments.

h. The HPA accepts the upconverter signal and produces an output signal at up to 57.6 dBm (575 Watts) with an instantaneous bandwidth of 40 MHz.

i. The power combiner permits the summing of the outputs of two upconverters. It can be used to combine the signals from the AJCM and a MD-945 modem after passing through their respective upconverters. The two signals need to be within a 40-MHz bandwidth for application to an HPA. The AN/TSC-94A is not designed for multicarrier operation, but can operate in a node where the signals from an AJCM and a MD-945 modem are combined, either in the power combiner or before the upconverter in the modem interface assembly. There are four RF transmit modes of operation within the AN/TSC-94A.

(1) Single Carrier With One HPA. The 70-MHz IF carrier received from the modem is upconverted to the transmit RF, amplified by the HPA, and routed to either the antenna or dummy load.

(2) Two Separate Carriers With Two Upconverters and One HPA. The 70-MHz IF output of a digital data modem and an AJCM are upconverted to separate RF carrier signals, combined into a single transmission signal by the power combiner, amplified by a HPA, and routed to either the antenna or dummy load.

(3) Coherently Combined HPA Outputs With a Single Carrier. The 70-MHz IF carrier from the modem is upconverted to transmit RF, divided into two signals with a 90° phase differential between them by a phase shifter, and amplified separately by two HPAs. The output of both HPAs is coherently combined for maximum power output, and the input is applied to either the antenna or dummy load.

(4) Coherently Combined HPA Outputs With Two Separate Carriers. Two 70-MHz IF carriers from a digital data modem and an AJCM are upconverted to transmit RFs. The two upconverter signals are combined into one transmission signal by a power combiner. The output of the combiner is routed to a phase shifter where the signal is split into two signals with a 90E phase differential, and each is amplified by a HPA. The two HPA signals are then coherently combined and applied to either the antenna or dummy load.

(a) The receiver group accepts an RF signal in the 7.25 to 7.75 GHz range from the antenna group and amplifies and downconverts it to a 70-MHz IF signal for application to the modem group.

(b) The major end items in the AN/TSC-94A (V)1 and (V)2 are shown in Table D-A-C-2.

3. Physical Description. The terminal electronics equipment in the AN/TSC-94A is housed in a S-250 shelter. Inside the shelter, there are the roadside equipment racks containing the RSS, the curbside equipment racks containing the CSS, and ECU. On the outside shelter wall, there are sealed entry panels to accommodate signal and power cables. The (V)1 shelter can be mounted on an M-720 transporter. An M-832 transporter is used for the (V)2 shelter. The (V)1 terminal requires two M35 trucks, one for carrying the power generators and towing the shelter and the other for carrying auxiliary equipment used in the terminal. The (V)2 terminal requires one M-923 truck to tow the shelter and carry auxiliary equipment.

4. Antenna. The AN/TSC-94A normally uses an 8-foot parabolic antenna. It is a right-hand circular polarized transmit antenna and a left-hand circular polarized receive antenna. The KG-84(V) encrypts the data and returns them as 2-Kbps CESE encrypted data. The characteristics and setup of the TSSP are covered in Annex A.

5. Baseband Multiplex Equipment. The multiplexer group provides the interface between external analog and digital signals and the modem group.

a. TD-1337 Tactical Satellite Signal Processor

(1) The TSSP combines inputs from the LRMs, an external conditioned diphase group, a 16-Kbps orderwire, and encrypted CESE data (2 Kbps) into a composite signal with a data rate related to the sum of the input rates plus overhead bits. The composite data rate for the TD-1337(V)4 used in the AN/TSC-94A(V) ranges from 16 to 1,688 Kbps in 8-Kbps increments.

(2) The TSSP monitors 56 communication equipment support element CESE status points, formats them into a block message, and applies it to a KG-84(V) as 150 bps CESE data. The KG-84(V) encrypts the data and returns them as 2 Kbps CESE encrypted data. The characteristics and setup of the TSSP are covered in Annex A.

Table D-A-C-2. AN/TSC-94A(V) Major Equipment Items

Nomenclature	(V)1	(V)2
Multiplexer Group/Baseband Equipment		
TD-1389(V) (LRM)	2	1
TD-1337 (TSSP)	1	1
KG-81 (TED)	2	1
KG-84(V) (GPEE)	1	1
KY-58 (VINSON)	1	1
CV-3896 (Level Converter)	2	2
Modem Group		
MD-945/TSC (Digital Data Modem)	2	1
RT-1287 (Orderwire) 1/	1	1
Transmit Group		
C-11375	1	1
Coherent Combiner	1	1
AM-6701 (HPA)	2	2
PP-7086 (HVPS)	2	2
CV-3198B (Up-Converter)	2	2
Receive Group		
AM-7227 (LNA)	2	2
CV-3210B (Down-Converter)	3	3
C-11109A	1	1
LNA Bite Unit	1	1
Wideband Preselector	1	1
Antenna Group		
AS-3036 (8 ft antenna)	1	1
C-10273 (DSCSU)	1	1
C-10817 (RCU)	1	1

1/ As part of the AJCM fielding, the RT-1287 was removed. In addition, a power monitor system will be added. (See Annex F.)

b. TD-1389 Low Rate Multiplexer. The LRM is an adaptive time division multiplexer (ATDM) that multiplexes up to 12 full-duplex data channels into a NRZ or CDϕ composite signal. The input data rates vary from 37.5 bps to 56 Kbps depending on the application. The composite output rate is the sum of the channel input rates plus over-head framing bits and cannot exceed 256 Kbps. The LRM can interface with single channel digital, FSK, or analog voice inputs. The LRM is the primary user interface device for the AJCM. When operating with the AJCM, the maximum LRM composite rate is 32 Kbps. In the group modem mode, it can also accept a CDϕ group input at 256 Kbps or less. The LRM characteristics and operation are covered in Annex A.

c. Trunk Encryption Device. The TED performs full-duplex, digital data encryption or decryption to the transmit or receive signal from the LRM.

d. KG-84A General Purpose Encryption Equipment. The KG-84A encrypts information messages that pertain to the status of the terminal. The TSSP accumulates the status information, sends it to the GPEE for encryption, and receives this status information back for transmission.

e. KY-58 VINSON. The KY-58 VINSON is a secure voice unit that digitizes and encrypts the audio input signal into a 16-Kbps data stream.

6. Modem Equipment. The modem group provides the interface between the baseband multiplex equipment and the transmit and receive equipment. The AN/TSC-94A modem group consists of the MD-945 digital data modem, SAW filters, the AJCM, and the modem interface assembly.

a. MD-945 Digital Data Modem. The MD-945 provides the signal interface between the TSSP and the upconverters and D/Cs in the radio group. It accepts the unbalanced NRZ composite output from the TSSP and converts it to a modulated 70-MHz signal. The modem can be configured to use either BPSK or QPSK modulation techniques. Using BPSK modulation, the modem can operate at data rates from 16 Kbps to 2.499 Mbps. If configured for QPSK modulation, the modem can support data rates from 200 Kbps to 4.999 Mbps. The MD-945 is normally configured to use QPSK modulation.

b. Nonnodal Terminal Antijam/Control Modem. The NNT AJCM is a processor-controlled spread spectrum modem that provides a full-duplex, secure, jam-resistant communications link over a GMF satellite link. (See Annex F.) On the cable side, the AJCM interfaces with LRM composite output (75 bps to 32 Kbps) or with a single 75-bps teletype signal from the VF/data entry panel. The output of the AJCM is a 70-MHz IF signal. The AJCM is always online, even when there is no jamming.

7. <u>Interfaces</u>. The user circuits pass through either the TD-1337(V)4 TSSP or the MD-1131 AJCM. Circuits transmitting the TSSP may or may not pass through TD-1389 LRMS. (Annex A and Annex F provide a full description of the TD-1337 and the AJCM and the limitations on inputs passing through them.) Figure D-A-C-2 depicts the baseband equipment connectivity. Signals enter the AN/TSC-94A through either the signal entry panel or the VF/data entry panel. There are no two- or four-wire converters or signaling converters in the AN/TSC-94A. If this equipment is needed, it must be provided externally. The typical interfaces to the AN/TSC-94A are discussed in the following subparagraphs.

a. <u>Direct TD-1337 Conditioned Diphase Group Input</u>. This is a direct connection to the TD-1337 from an external CDϕ multiplexer or group modem. The CDϕ signal enters the AN/TSC-94A through the SEP. The maximum data rate is 1,152 Kbps (requires two TSSP ports to be strapped together). The TEDs in the AN/TSC-94A cannot be used to encrypt this input.

b. <u>Individual Channel Inputs Through the TD-1389 LRM</u>. These interfaces may be analog, FSK, CDϕ, or NRZ data. (See Annex A for the limitations on each type of input.) The physical interface is provided by 26 pair cable hocks and/or binding post connectors located on the VF/data entry panel. Both the data and the timing 26-pair cables are paralleled with binding posts connectors. The AN/TSC-94A(V)1 has two LRMs with a maximum of 24 inputs while the AN/TSC-94A(V2) has one LRM with a maximum of 12 inputs. The group output of the LRM can be connected to the TD-1337 TSSP or the AJCM. The LRM is the primary user interface to the AJCM. (See Annex F.)

c. <u>Group Input Through the LRM</u>. The LRM must be configured for GM mode operation. This mode allows one CDϕ group input through TD-1389 LRM number one. Allowable data rates are 72, 127, 144, and 256 Kbps. The physical interface is via CX-11230 cable connected to the SEP. The LRM interfaces the group to the TD-1337. The TEDs in the AN/TSC-94A may be used to encrypt this group. (See Annex A.)

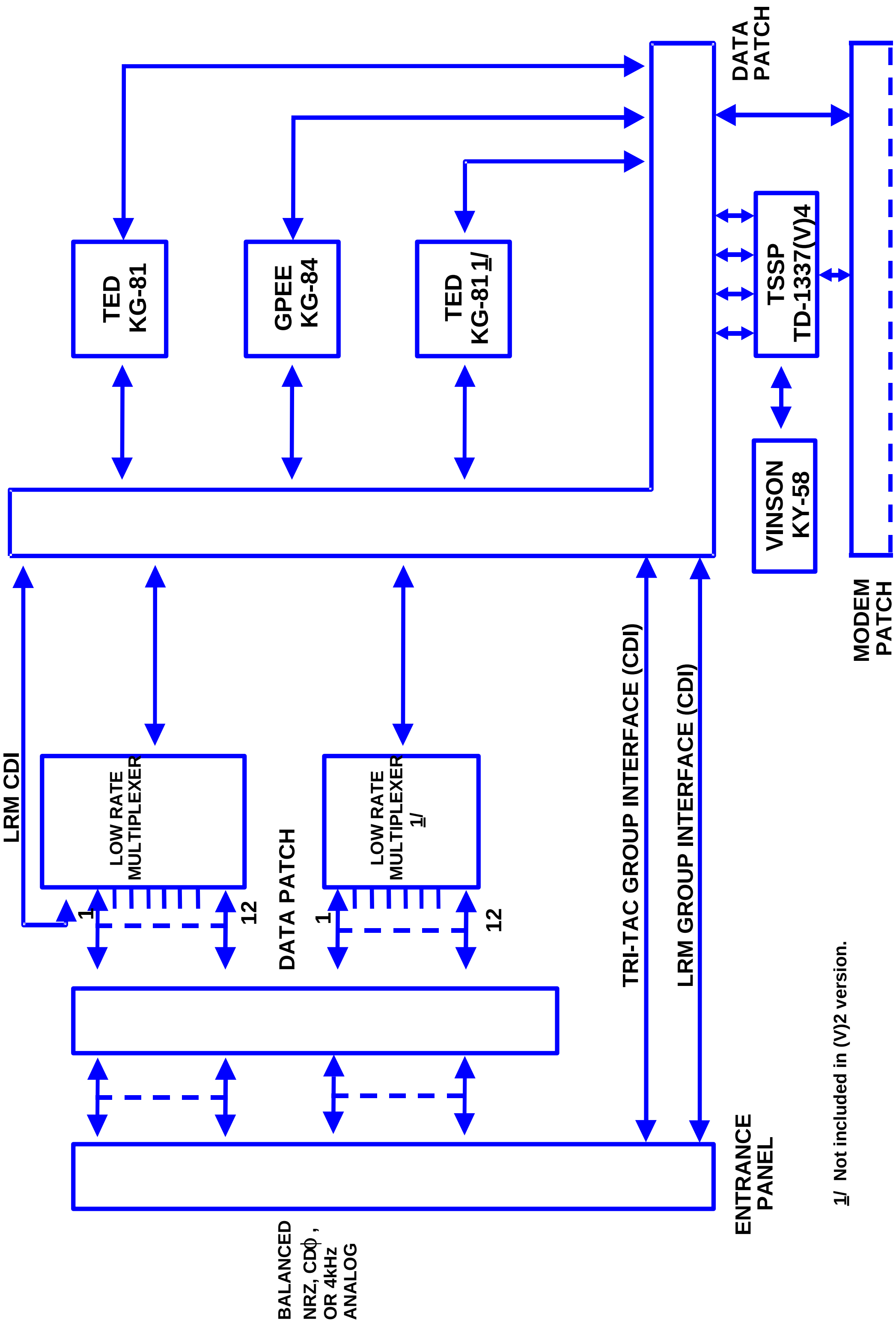

Figure D-A-C-2. AN/TSC-94A Baseband Configuration

d. 70-MHz IF. There are two separate 70-MHz, 50-ohm inputs for the transmit and receive IF.

e. AJCM TTY Interface. This is a direct user interface to the AJCM via binding post connectors on the VF/data entry panel. The NNT AJCM can support a single channel TTY circuit in lieu of the LRM composite group. The data rate for the TTY interface is 75 bps.

8. Orderwires. The AN/TSC-94A incorporates several different orderwire capabilities. Appendix B to Enclosure A covers the operation and interoperability of the different orderwires. There is a 16-Kbps digital voice orderwire built into the TSSP. The orderwire may be secured by a KY-58 VINSON or operated nonsecure. Another orderwire capability exists through a receiver-transmitter orderwire RT-1287/TSC, which interfaces with the MD-945 modem. This is a nonsecure voice orderwire used for coordination and control purposes with the control terminals and other network terminals. This orderwire is deleted when the AJCM is installed. The shelter is equipped with a TA-312 analog telephone for use in local coordination.

9. Patching. Patch panels are provided to isolate equipment groups and facilitate the interconnection of system components to form various configurations. The five patch panels within the AN/TSC-94A are the data, modem, IF, SHF, and orderwire. All individual baseband signals as well as the LRM composite signals appear at the data patch panel. The modem patch panel is the interface point between the multiplexer group and modem group. The IF patch panel is the interface point at 70 MHz between the modem and the transmit/receive groups. An orderwire patch panel is used to interface the frequency modulation (FM) orderwire and the MD-945 Modem. At the transmit RF level, the SHF patch panel is used to interface the upconverters with the HPA.

ANNEX D TO APPENDIX A TO ENCLOSURE D

AN/TSC-85B(V) SATELLITE TERMINALS

1. Introduction. The AN/TSC-85B(V) Nodal Mesh Terminal (NMT) is a full-duplex, satellite communications terminal capable of interfacing with a single satellite. It operates in a point-to-point configuration, a nodal configuration with up to four other terminals, or in a mesh configuration with up to four other terminals. It transmits a single carrier and receives between one and four carriers. Table D-A-D-1 presents the principal characteristics of the AN/TSC-85B(V). There are two versions of the AN/TSC-85B: the (V)1 version used by the Army, Marine Corps, and JCSE, and the (V)2 which supports NATO air bases.

Table D-A-D-1. AN/TSC-85B(V) Technical Characteristics

Characteristic	Value
Terminal	
Frequency	
Transmit	7.9-8.4 GHz
Receive	7.25-7.75 GHz
Antenna, AS-3036	
Reflector	8 ft, parabolic
Power Output (Watts)	500 (nominal)
Antenna, OE-361	
Reflector	20 ft, parabolic
Power Output (Watts)	2 kW
User Interfaces (Individual)	
Analog	300-3400 Hz bandwidth (CVSD interface with LRM)

Table D-A-D-1. (Cont'd)

Characters	Value
Digital	16/32 Kbps CDϕ digital voice (LRM) 0-56 Kbps CDϕ digital data (LRM) 16/32 Kbps CDϕ (Dedicated user to TSSP) 72, 128, 144, 256 Kbps CDϕ (via LRM) 32 Kbps CDϕ (direct to AJCM)
FSK	0-1.2 Kbps (LRM)
IF	70 MHz (bypasses multiplex and modem groups within shelter)
User Interfaces (Group)	
CDϕ Bipolar	≤ 1,152 Kbps 4,915.2 Kbps
Transmitter Units	
<u>Power Amplifier</u>	
Frequency Range	7.9-8.4 GHz
Bandwidth	40 MHz
Power Output	630 Watts (maximum)
<u>Upconverter</u>	
Input Frequency	70 MHz ≤ 20 Hz
Frequency Selection	0.1 MHz steps
Receiver Units	
<u>LNA Assembly</u>	
Frequency Range	7.25-7.75 GHz
Bandwidth	500 MHz
Gain	3-43 dB

Table D-A-D-1. (Cont'd)

Character	Value
Downconverter	
RF Input Frequency	7.25-7.75 GHz
Frequency Selection	0.1 MHz
IF Output Frequency	70 MHz ± 20 MHz
Modem	
Input/Output Levels (Data)	
PCM-NRZ Logic 1 Logic 0	0.0 to -0.4 V -2.2 to -2.6 V
Output Levels (Timing)	
PCM Baseband (Logic 0)	-2.2 to -2.6 V
Peak (Logic 1)	0.0 to 0.4 V

2. AN/TSC-85B(V) Functional Description. A functional block diagram of the AN/TSC-85B(V)1 is shown in Figure D-A-D-1. A brief description of the operation of the terminal is given below.

a. General. The AN/TSC-85B(V) can accept and process up to 101 external loop circuits or eight externally multiplexed groups or a combination of loop circuits and groups. Ninety-six of the 101 loop circuits interface with the terminal via the VF and digital entry panels and are multiplexed by the TD-1389 LRM. Another loop circuit enters the terminal via the data entry panel, Dedicated User pushpin binding posts. This circuit is multiplexed within the online TSSP. Four individual teletype circuits may enter the terminal at the roadside data entry panel on the baseband digital group transmit pushpin binding posts A-D and are processed by the AJ modem group. All eight groups are provided access to the terminal via the data entry panels. Three groups, marked GM line signals, are wired directly to the MD-1026 GM. Three groups, marked AJ data and baseband digital on the entry panel, are patched to the AJ modem group. One group appears on the data entry panel as MUX/TRI-TAC and, if used, is ported to the TSSP.

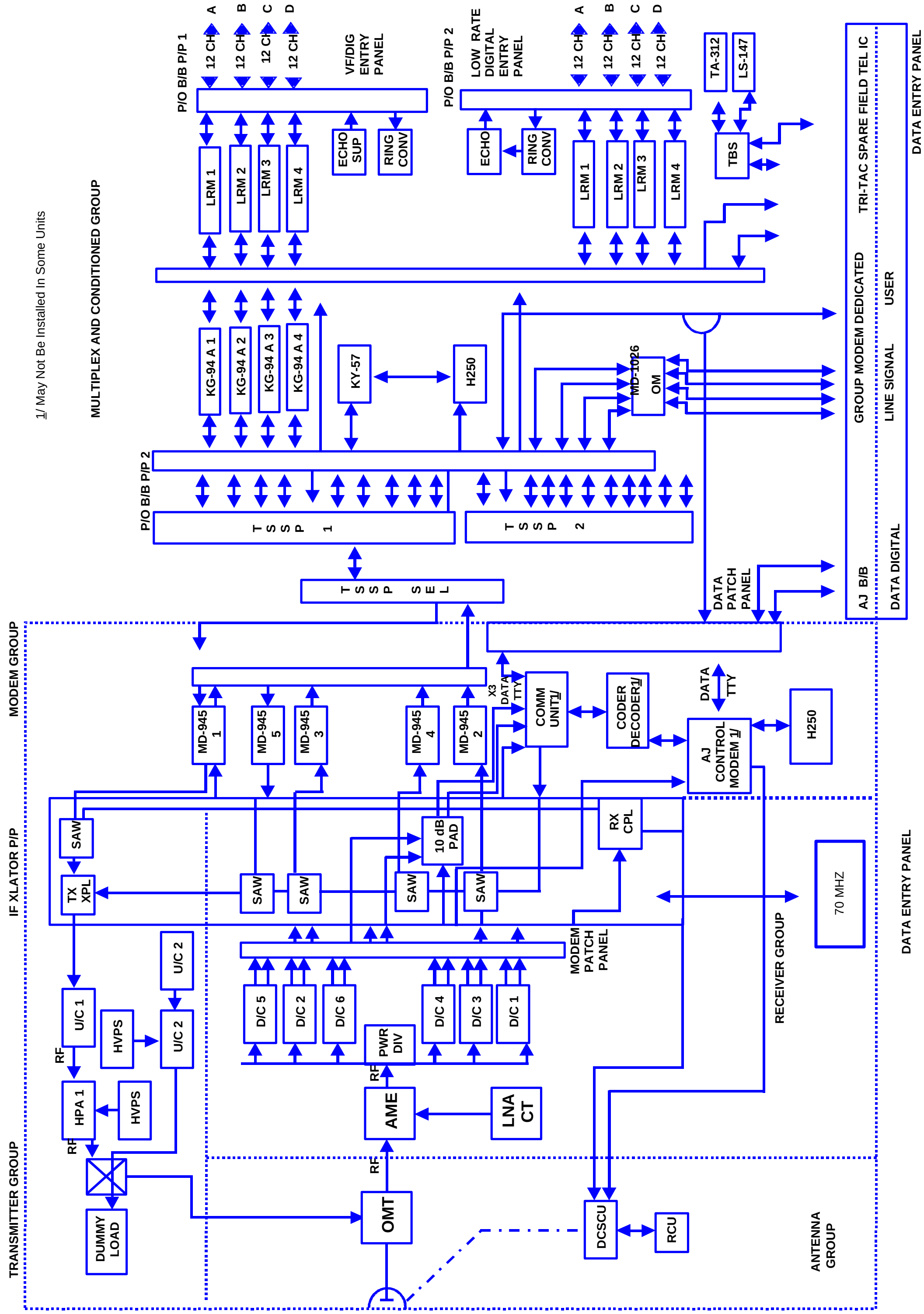

Figure D-A-D-1 AN/TSC-85B (V) 1 Functional Block Diagram

b. <u>KG-94A Trunk Encryption Devices</u>. The TEDs encrypt up to four individual groups. Each of these TEDs is normally wired through to a corresponding LRM. That is, LRM Group A is normally wired through the Baseband Patch Panel #1 to TED 1, LRM Group B is normally wired through to TED 2, etc. The TD-1337 TSSP combines up to eight group inputs. These inputs may be from LRMS, from the GM, and/or from the TRI-TAC MUX group input. The combination of group inputs, a 16-Kbps orderwire, a dedicated 16- or 32-Kbps user loop, and 8 Kbps of overhead make up the supergroup bit stream.

c. <u>MD-945 Digital Data Modem</u>. The DDM uses BPSK or QPSK modulation. The satellite side output is a nominal 70-MHz IF signal. Only one of the five DDMs is used to transmit the composite signal received from the active TSSP. Because of the physical locations and wiring of the DDMs, only modem one or five may be used as the online modem supporting supergroup transmit functions.

d. <u>Surface Acoustic Wave Filter</u>. The SAW filter compresses the transmit IF signal from the MD-945 and eliminates unwanted sidelobes.

e. <u>Nodal AJ Modem Group</u>. This group consists of the MD-1131/G and the MD-1132/G Digital Data Modems and the OX-64/G Coder Group. The items are commonly referred to as the control modem, communications unit, and the ten-channel transmission security (TRANSEC) unit, respectively. The group provides full-duplex, AJ data communications with up to four other satellite terminals. Each of these four AJ links supports data rates from 75 bps to 32 Kbps. A fifth AJ link, operating at 75 bps with the satellite control terminal, provides a means of transmitting and receiving satellite systems control information. The AJCM also provides a means of distributing the 5-MHz timing signals throughout the terminal. In addition, the AJCM automatically reports back the transmit power through the polling channel of the AJ modem from each terminal. The equipment within the AJ group and multiplex and conditioning group act upon received signals in a manner opposite to that described in the transmission path of the same type signal.

f. <u>Transmit Coupler</u>. The coupler sums the 70-MHz signals from either MD-945 number one or five and the AJ Communications Unit. The summed signal is passed to either of the two upconverters. The selected upconverter accepts the summed 70-MHz transmit signal and produces an output signal between 7.9 and 8.4 GHz with a bandwidth of 40 MHz. The output center frequency is selectable in 100-kHz increments.

g. External 70-MHz IF Interface. This interface is available at the shelter wall and is extended to the Translator Patch Panel. Use of this interface entails the employment of an external modem capable of supporting 70 MHz. The transmit side of this interface may be interconnected with either the transmit SAW filter or the transmit coupler or may be patched directly to the online upconverter. The use of an external IF precludes the employment of the multiplex and conditioning group, but does allow for the use of the AJ group depending upon system requirements.

h. High-Power Amplifier. The HPA accepts the output of the upconverter and produces a maximum amplified output signal of 630 watts.

i. Transmit RF Signal. This signal is routed through a waveguide switch to the OMT. The OMT also receives signals from the antenna. Signals destined for the antenna and those destined for the AME are directed by the OMT to their immediate destination. The AME consist of a receive directional coupler, a wideband preselector, a receive waveguide switch, two LNAs, and an LNA BITE box. The receive directional coupler accepts either the signal from the antenna or allows for the injection of a test signal. It passes either of these signals to the wideband preselector. The wideband preselector rejects all signals except those between 7.25 and 7.75 GHz which it passes to the receive waveguide switch. The waveguide switch selects either of the two LNAs to amplify the received SHF signal. A single LNA BITE box that contains a test oscillator and a fault detector for testing the standby LNA is associated with the two LNAs.

j. Online LNA Signal. The signal received from the online LNA is divided six ways. Each of the six outputs is directed to one of the six D/Cs. Four of the D/Cs normally numbers one, two, four, and five select carrier signals from each of the four possible distant satellite terminals and pass the resultant 70-MHz IF signals to one of four MD-945 modems. The fifth D/C, normally number three, supports the CCC, which is received from the satellite control terminal. The sixth D/C is operated in a standby mode. The normal selection of D/Cs and MD-945s is due to the placement of the equipment within the racks.

3. AN/TSC-85B(V) Physical Description. The terminal electronics equipment is housed in a S-280/G modified shelter. Table D-A-D-2 lists the major end-items contained within the AN/TSC-85B(V).

4. Antenna. The AN/TSC-85B(V)1 normally uses an 8-foot parabolic antenna, AS-3036/TSC. This is a right-hand circular polarized transmit and left-hand circular polarized receive antenna system. The AN/TSC-85B(V)2 uses the OE-361 a 20-foot quick reaction satellite antenna group (QRSAG).

5. Multiplex and Conditioning Group. The multiplex and conditioning group provides the interface between the external analog and digital signals and the modem group.

a. Conditioning Equipment. The terminal contains two strings of analog conditioning equipment. Each string consists of a CV-1548 two-/four-wire converter ((V)1 only) and a MX-9635/TSC echo suppressor. Each string may support up to 12 two-wire analog circuits. Access is provided via the Baseband Patch Panel. No circuit conditioning is provided for four-wire analog or for digital circuits.

b. TD-1389 Low Rate Multiplexer. The LRM is an ATDM. It can multiplex up to 12 full-duplex, digital, analog, or FSK signals depending upon the user interface cards provided and the data rates of the inputs. It accommodates input data rates from 37.5 bps to 56 Kbps, depending on the application. The composite output rate is the sum of the input rates plus overhead. The LRM composite rate cannot exceed 256 Kbps. The LRM can also accept a CDϕ group input at 256 Kbps or less. The LRM characteristics and operation are discussed in greater detail in Annex A. Four of the LRMs are normally employed in support of normal phase modulated mission traffic while the remaining four are employed in support of AJ traffic.

c. KG-94A Trunk Encryption Device. The TEDs perform encryption and decryption of group signals between the normal mission (non-AJ) LRMs and the TSSP. Access to the TEDs is provided via baseband patch panel number one.

Table D-A-D-2. AN/TSC-85B(V)1 Major Equipment Items

Equipment Item	Quantity	
	(V)1	(V)2
C-10273, Antenna Control Unit	1	1
AM-6701, HPA	2	2
CV-3198, Upconverter	2	2
CV-3201, Downconverter	6	6
MD-945, Digital Data Modem	5	5
TD-1337, TSSP	2	2
MD-1026, GM	1	1
C-11109, LNA Control/Translator	1	1
AM-6700, LNA	2	2
MX-9633A, Echo Suppressor	2	2
O-1677, Synthesizer	8	8
AS-3036, 8 ft. Antenna	1	0
OE-361, 20 ft. Antenna	0	1
Antenna Remote Control Unit	1	1
CV-1548, Converter	2	0
KG-94A, TED	4	4
TD-1389, LRM	8	5
MD-1131, AJ Control Modem 1/	1	1
MD-1132, AJ Communications Unit 1/	1	1
OX-64/G, Ten Channel TRANSEC 1/	1	1
AN/UGC-129, Teletypewriter	0	1
TA-838A, Telephone Set	0	1
Single Carrier Feed, OE-361	0	1
KG-84()	0	1
SG-1322, Frequency Standard	0	1
KY-57 2/	1	1

1/ May not be installed in some terminals.
2/ Supplied by using units.

d. MD-1026 Group Modem

(1) The GM accepts up to three external CDϕ group inputs or one external bipolar input. These inputs are converted to NRZ data and timing signals as required by the TSSP. The bipolar group rate of 4.9152 Mbps is the maximum data rate the TSSP can accept. The limitation in the number of CDϕ inputs (three) result from the fact that only three sets of diphase CCA are provided with the terminal. The fourth CDϕ group is supportable if the using unit procures a fourth set of CCAs.

(2) The supergroup output (satellite side) is an unbalanced NRZ signal ranging between 16 Kbps and 4,664 Kbps in 8 Kbps increments. The supergroup rate is the sum of the group input rates plus the rate of the dedicated user and the orderwire, if used, and 8 Kbps of overhead. In the MD-976 mode (bipolar operation) the supergroup rate is 4.9152 Mbps with no dedicated user or orderwire capability. The version of the TSSP employed in the AN/TSC-85B(V) does not provide data orderwire capabilities. Additional characteristics and the setup of the TSSP are covered in greater detail in Annex A.

e. TD-1337(V)1/G Tactical Satellite Signal Processor (TSSP). The TSSP accepts inputs from up to four equipment strings, each consisting of an LRM and a TED, or from the group modem, a 16-Kbps VINSON encrypted or nonencrypted digital voice orderwire, and a single dedicated 16- or 32-Kbps CDϕ user. Table D-A-D-3 lists the allowable combinations of these inputs.

6. Interfaces

a. Group Interfaces

(1) Conditioned Diphase. The data entry (signal) panel provides CX-11230 cable interfaces for up to six CDϕ groups. Four of these groups interface directly with the MD-1026 GM where they are converted to balanced NRZ signals. Only three CDϕ groups are supportable via the GM because only three sets of CDϕ CCAs are issued with the terminal. From the GM these groups are normally patched through B/B P/P 2 to ports 5, 6, 7, and 8 of the TSSP. Two other groups enter the shelter as TRI-TAC groups and appear on B/B P/P 1. Only one of these two TRI-TAC CDϕ groups may be patched to the TSSP and must occupy either port one, three, or five. The group data rate of the CDϕ groups may be

up to 1,152 Kbps, but at rates greater than 576 Kbps the port immediately following the port used will be unavailable for traffic. The second TRI-TAC interface is a spare.

Table D-A-D-3. TD-1337(V)1/G Input Configurations

TSSP Port	Unbalanced NRZ	Balanced NRZ	CDϕ	Bipolar
1 1/	288-1152	8-1152	72-1152	-
2	288-576 2/	8-576	-	-
3	288-1152	8-1152	72-1152	-
4	288-576	8-576	-	-
5	-	8-1152	72-1152	-
6	-	8-576	-	-
7	-	8-1152	-	-
8	-	8-576	-	4,915.2 3/

1/ Each TSSP port may accept only one type and rate of input.
2/ Group data rates of 1,024 and 1,152 Kbps are handled by autostrapping two ports within the TSSP. Groups must be assigned to an odd-numbered port and the next even-numbered port is not available for use.
3/ No orderwire or dedicated user circuit is available while the TSSP is functioning in the TD-976 mode. Also, this option is usable only if the distant terminal employs a TD-1337(V)1/G, since the (V)2, (V)3, and (V)4 do not support the TD-976 mode.

(2) Bipolar. A single set of CCAs that support bipolar operation is provided with the terminal. This set is made up of a bipolar CCA and an orderwire CCA. Because port 8 of the TSSP is the only port that will accept a bipolar group, the group should enter the terminal at the GROUP MODEM LINE SIGNAL 4 entry, and the two CCAs should be employed in GM card slots 11 and 12. This equates to GM Group 4. As shown on the B/B P/P number 2, group 4 of the GM is normal through to port 8 of the TSSP.

(3) 70-MHz Intermediate Frequency. The data entry panel provides an interface for a single, external, multiplexed, and modulated 70-MHz IF signal. On the transmit side, this signal interfaces via the IF translator patch panel with either the upconverter or the transmit coupler or with the transmit SAW filter, depending upon system requirements. On the receive side of the 70-MHz interface, appearance on the patch panel may be extended from either the D/C supporting mission traffic or the receive SAW filter associated with this D/C to the shelter wall. Use of the external 70-MHz interface precludes the use of the MD-945s and the equipment within the multiplex and conditioning group that support the MD-945s.

b. Single Channel Interfaces

(1) Dedicated User Port. The data entry panel also provides access for a single 16- or 32-Kbps CDϕ Dedicated User. This dedicated user interface is normally through to the TSSP 2 Dedicated User port. Only one of the received supergroups will contain the dedicated user circuit data. That particular supergroup must be identified during the programming of the TSSP to complete the routing of data to the dedicated user appearance on the baseband patch panel. If TSSP 2 is to be placed online and the dedicated user interface is to be accommodated, it must be patched to TSSP 2.

(2) Analog. Non-FSK analog loop signals are converted to digital signals by the CVSD cards supplied with the terminal. The maximum number of these types of loops that can be supported is 52. The restriction is due to the number (52) of CVSD cards provided. If the terminal is operated with four LRMs in support of AJ communications, and these carry FSK traffic, the maximum number of non-FSK analog loops supportable is reduced to 48, 12 for each of the four LRMs in support of normal mission traffic. If the voice digitization rate of 32 Kbps is to be supported on all analog to digital circuits, the maximum number supportable is 28. That is, each of the four LRMs can support only seven 32 Kbps circuits with a combined input rate of 224 Kbps. This combined input when added to the overhead of the LRM is the largest composite rate (256 Kbps) allowable.

(3) Digital. A maximum of 48 16-Kbps digital loops may be supported through the use of the 48 digital interface cards supplied with

the terminal. Note that the maximum composite input to any LRM is 247 Kbps. This restriction precludes the interfacing of more than seven digital circuits at the 32-Kbps rate to any single LRM. This restriction limits the number of 32 Kbps digital loops supportable via the four LRMs to a total of 28.

(4) FSK. The terminal is supplied with a total of 24 FSK interface cards. Up to 12 cards may be employed with any single LRM. These interface cards are normally associated with the low-rate entry panel and LRMs five through eight and the AJ modem group.

7. Modem Group. The modem group is composed of a transmit coupler, a receive coupler, and the SAW filter unit. Also included are five MD-945 modems and the AJ modem group.

a. MD-945 Data Modems. Up to four MD-945 modems may support traffic within the terminal at any given time. The fifth is operated in a standby mode, normally backing up modem number one.

(1) Each of the five modems is capable of supporting NRZ transmit and receive data at rates between 16 and 4,999 Kbps. Data in the modem are always differentially encoded. Differential coding is a form of signal conditioning and provides for no forward-error correction. When the CODED/UNCODED switch is in the CODED position, the data are also convolutionally coded. Convolutional coding provides forward-error correction and thus allows data to be passed over systems with high bit error rates. The use of convolutional coding increases the radio bandwidth required to pass mission data.

(2) The MD-945 modems operate in either the BPSK or the QPSK mode. In the BPSK mode, the phase of the 70-MHz output signal is shifted between 0^0 and 180^0 with respect to the input signal. In the QPSK mode, the 70 MHz signal is shifted in four phases: 0, 90, 180, and 270^0. The use of QPSK has the effect of reducing the mission bandwidth by one half. The operating mode is determined by the transmit data rate and the available system bandwidth. For input data rates between 16 and 99 Kbps, only the BPSK mode is permissible; for rates between 100 and 2,499 Kbps, either BPSK or QPSK may be used. For input data rates between 2,500 and 4,999 Kbps, only the QPSK mode is available.

b. AJ Modem Group. The AJ modem group is made up of the MD-1131/G Digital Data Modem, an MD-1132/G Communications Unit, and the OX-64/G Coder/Decoder transmission security equipment. Each of these equipment will be discussed below.

(1) The MD-1131/G Digital Data Modem provides distribution of the 5-MHz reference frequency. The 5-MHz signal is obtained from either the upconverter or, if available, from a timing standard. The modem also provides two digital data communications circuits or one digital data and one voice circuit. Each of these circuits is discussed in detail in subparagraphs 7c, 7d, and paragraph 8.

(2) The MD-1132/G Communications Unit supports up to three LCC/VCC circuits. Calls over VCC circuits 2, 3, and 4 are initiated from the communications unit front panel. With multiple terminals operating with an AN/TSC-85B, any distant terminal can capture the AN/TSC-85B VCC; however, the AN/TSC-85B can communicate with only one distant terminal at any given time.

(3) The OX-64/G Coder/Decoder (10-channel TRANSEC) provides protected transmission and reception of the CCC and up to four LCC or VCC signals. The Coder/Decoder is controlled by the Control Modem and may be turned either On or Off. It is normally in the On position.

c. Critical Control Circuits. The CCC is a 75-bps circuit that provides a means for network command and control. The circuit is operated in the broadcast mode between the NCT and the AN/TSC-85B(V)1 and other network terminals. The NCT establishes the network by acquiring a beacon signal for frequency and synchronization purposes. The NCT then activates each individual terminal control modem. Optimal network parameters are maintained by the NCT monitoring the satellite signal frequency and amplitude and by using these data to compute the conditions necessary to maintain the system at an optimum level. Automatic control of the network is maintained by command signals being transmitted to each control modem in the system via the CCC. Responses to these commands from the terminals result in such activities as turning on the terminal control modem modulator or returning status information via the CCC in response to a polling request.

d. Link Communications Circuit. The LCC is a digital data, 75 bps to 32 Kbps, circuit between terminals. Normally, the data carried over this circuit enter the terminal as FSK signals via one of the low-rate entry panels and are multiplexed by an LRM. The data rate of the LCC circuit may be changed as stress conditions change. The terminal operator at either end of a link that has been determined to be under stress will be directed by the satellite controller to reduce the data rate of the LCC. The terminal operator who has been directed to reduce the data rate of the LCC will input the data rate change into the AJCM interface control unit and initiate the date-rate change as described in the AJCM operator's manual. The initiating terminal commands to the distant terminal and the handshaking required to effect the data rate change are accomplished via the LCC. The distant terminal operator has up to 3 seconds to confirm acknowledgment of the data rate change and once acknowledged, up to 30 seconds to accomplish the required terminal reconfiguration. If data resynchronization is not accomplished within 30 seconds, the data rate of the LCC automatically defaults to 75 bps (AUTO 75) and the data rate change process is repeated. During data rate change periods, the LCC is not available for use traffic. In a jamming environment, the LCC may be the only data communications capability available between terminal users.

8. Voice Communications Circuit. The VCC is a 16-Kbps DVOW circuit between terminals. This circuit is used in nonstressed environments. Operator access to the VCC is via a H-250 handset that plugs directly into the control modem front panel. Voice calls associated with VCC 1 are initiated from the control modem front panel. While VCC calls are in process, the associated LCC is not available for use. The VCC is not extendable outside the terminal. The circuit is available only between terminals that have direct, over the spacecraft contact such as between two AN/TSC-85Bs or between an AN/TSC-85B and an AN/TSC-93B.

9. Patching. Patch panels are provided to isolate equipment groups and facilitate the interconnection of system components to form various configurations. The six patch panels within the terminal are the two baseband patch panels, the TSSP select panel, the data patch panel, the modem patch panel, and the IF translator patch panel.

a. Baseband Patch Panel (B/B P/P) Number One. Baseband patch panel number one accommodates signals to and from VF/digital entry panels A through D. The TRI-TAC and SPARE CDϕ group signals from the data entry panel are also accommodated by this patch panel. Within the terminal, B/B P/P number one accommodates signal flow between half of the circuit conditioning equipment, LRMs one through four, and the four KG-94A TEDs. Signal flows to and from the composite outputs of LRMs five through eight are also accommodated. Patch (1) provides echo suppression and ring conversion for a two-wire analog user. Patch (2) interfaces the composite input/output of LRM eight with LCC port on the MD-1131 Digital Data Modem. Normally, the composite input/output of LRM five through eight are wired through to AJCM ports 1 through 4. Patch (3) extends a multiplexed TRI-TAC group from the TRI-TAC input on the data entry panel to the CDϕ input on TSSP #1. Patch (4) extends a CDϕ group to LRM #1 from the SPARE multiplexed TRI-TAC appearance on the data entry panel.

b. Baseband Patch Panel Number Two. Baseband patch panel number two accommodates signals to and from the low-rate digital entry panels A through D and the DEDICATED USER signals from the data entry panel. Within the terminal, B/B P/P two accommodates signal flow between half of the circuit conditioning equipment, LRMs five through eight, the four groups of the GM, and between the TEDs and the TSSP.

c. TSSP Select Panel. This panel provides for the selection of either TSSP one or two as the online TSSP. Normally, TSSP one is placed online.

d. Data Patch Panel. This panel accommodates signals to and from the binding posts labeled AJ DATA and BASEBAND DIGITAL on the data entry panel. Within the terminal, the data patch panel accommodates signal flow between the AJ Group and the B/B P/P.

e. Modem Patch Panel. This panel accommodates signal flow between the TSSP select panel and each of the five MD-945s and between each of the D/Cs and the IF translator patch panel.

f. IF Translator Patch Panel. This patch panel accommodates all signals that require patching between the modem group and the transmitter and receiver groups.

10. Signal Entry. Signal entry panels are located on the exterior roadside, curbside, and rear of the terminal shelter. These panels accommodate all types of signals from voice to radio frequency.

a. Curbside Panels. Two sets of signal entry panels are located on the curbside of the shelter. The first set accommodates four groups, A through D, of VF/digital loop signals, each via a U-187A/G 26-pair cable hock. The second panel also accommodates four groups, A through D, low-rate data loop signals, each via a U-187A/G 26-pair cable hock.

b. Rear Panel. The antenna entry panel provides entry for SHF receive signals from the antenna and egress for SHF signals, antenna pointing signals, and signals from the LNA test translator. Power to the antenna is also provided through this panel.

c. Roadside Panels. Two separate panels are located on the exterior, roadside, of the shelter.

(1) The data entry panel accommodates four loop groups of NRZ type signals that are available for use in lieu of the four LRM group interfaces to the AJ group. The transmit pairs of each of these four group interfaces may accommodate TTY signals in lieu of a group. These TTY signals are also usable in lieu of the LRM groups as interfaces with the AJ equipment. Also, a part of this panel, DEDICATED USER, appears within the shelter on B/B P/P two and may be patched as required.

(2) The second roadside panel is identified as the Signal Entry Panel and provides access and egress for each of the four CDϕ groups associated with the MD-976 Group Modem. This panel also accommodates the MUX/TRI-TAC and SPARE group and some internal single loop connections such as the field telephone and the intercom. Finally, this panel accommodates the externally multiplexed 70-MHz IF.

ANNEX E TO APPENDIX A TO ENCLOSURE D

AN/TSC-100A SATELLITE TERMINAL

1. AN/TSC-100A Nodal Mesh Terminal. The AN/TSC-100A NMT is a full-duplex, satellite communications terminal that is capable of interfacing with two satellites, simultaneously. It operates in a point-to-point configuration, a nodal configuration with up to four other terminals, or a mesh configuration with up to four other terminals. It transmits and receives up to four carriers. The principal characteristics of the AN/TSC-100A are in Table D-A-E-1. There are two versions of the AN/TSC-100A: the (V)1 and (V)2.

2. AN/TSC-100A Functional Description. A functional block diagram is shown in Figure D-A-E-1. A brief description of the operation of the terminal is given below. Planners desiring a more detailed description should consult the appropriate technical order.

a. The AN/TSC-100A provides interfaces for both individual channels and up to five digital groups. The AN/TSC-100A(V)1 can accept combinations of up to 72 individual channels (via six LRMs) and/or five groups. The AN/TSC-100A(V)2 can accept combinations of up to 60 individual channels (via five LRMs) and/or five groups.

b. Individual channels are connected to the TD-1389 LRM. The individual channels can be digital or analog depending on the application. Air Force LRMs are currently configured with three digital cards, three FSK cards, and six CVSD cards. The composite group output of the LRM may be connected to either the AJCM or the TSSP.

c. The TD-1337 TSSP combines up to 8 inputs from the LRMs and/or group inputs plus a 16-Kbps orderwire, a 16 or 32 Kbps dedicated user, and 8 Kbps of overhead into an unbalanced NRZ composite bit stream that is sent to the MD-945 modem. Up to four external group inputs may be connected to the MD-1026 and then to the TD-1337. A single CDϕ external group may be connected directly to the TD-1337 from the VF/Data SEP.

d. The MD-945 can be configured to use either BPSK or QPSK modulation techniques. Its output is a 70-MHz IF signal that is passed to the SAW filters. The SAW filters accept the 70-MHz IF signal from the MD-945 modems, compress the bandwidth, and eliminate unwanted sidelobes.

Table D-A-E-1. AN/TSC-100A Technical Characteristics

Characteristic	Data
Transmit Group	
Frequency Range (GHz)	7.9-8.4
Frequency Selection	100 kHz steps
Power Output @ shelter wall	
Coherently combined	62.4 dBm (1,740 Watts)
Combiner bypassed (each HPA)	60 (1,025 Watts)
Receive Group	
Frequency Range (GHz)	7.25-7.75
Frequency Selection	100 kHz steps
G/T (8 foot antenna)	18 dB/°K
G/T (20 foot antenna)	26.6 dB/°K
Antenna- 8 ft.	
Gain-transmit (dBi)	43.5
Gain-receive (dBi)	42.2
Polarization-transmit	Right-hand circular
Polarization-receive	Left-hand circular
Beamwidth-transmit	0.95°
Beamwidth-receive	1.10°
Antenna-20 ft.	
Gain-transmit (dBi)	50
Gain-receive (dBi)	50
Polarization-transmit	Right-hand circular
Polarization-receive	Left-hand circular
Beamwidth-transmit	0.5°
Beamwidth-receive	0.5°

e. The NT AJCM consists of the MD-1131 control modem, the MD-1132 communications units and the OX-64 coder group. It provides the capability for full-duplex, antijam data communications at data rates from 75 bps to 32 Kbps between GMF satellite terminals. The modem also provides the 74 bps CCC.

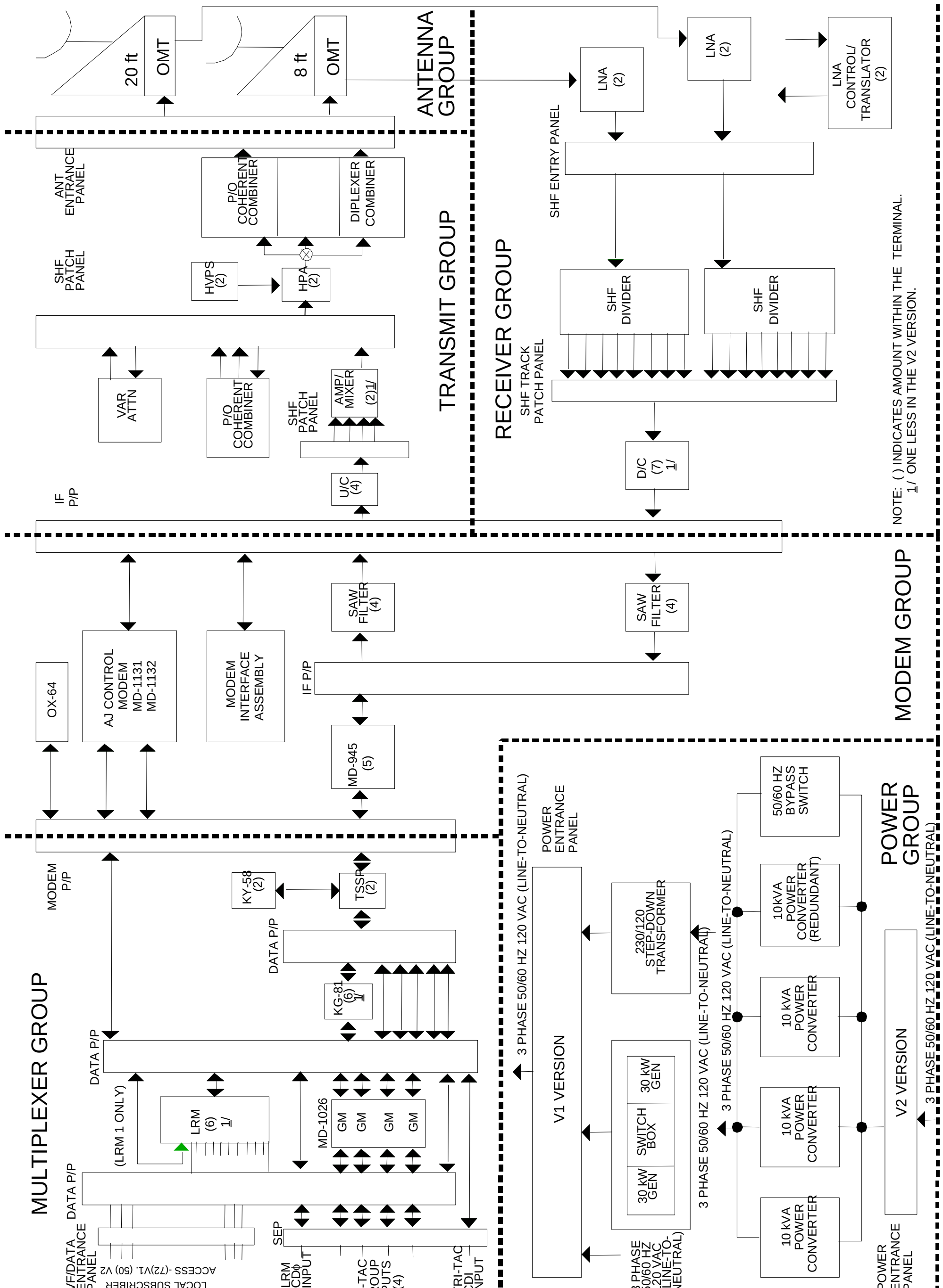

Figure D-A-E-1. AN/TSC-100A Functional Block Diagram

The NCT uses the CCC to control the AJ-protected network. See Annex B for more detailed information on the AJ modem.

f. The modem interface assembly accepts the 70-MHz IF outputs of both the MD-945 modem and the AJCM and combines them into a single 70-MHz IF signal. The combined 70-MHz IF signal is then provided to an upconverter. All input/output ports of the modem interface assembly appear on the IF patch panel.

g. The upconverter accepts the 70-MHz IF signal from the modem interface assembly and translates it to a frequency in the 7.9- to 8.4-GHz range, selectable in 100-kHz increments.

h. The HPA accepts the upconverter signal and produces an output signal at 60.1 dBm (1,025 watts) with an instantaneous bandwidth of 40 MHz.

i. The amplifier/mixer allows signals from up to four upconverters to be combined and applied to a single HPA.

j. The coherent combiner network combines the output signals from both HPAs coherently to achieve a higher output power. The output from a single upconverter is applied to an input hybrid that divides the signal and routes one leg to a phase shifter, which is used to ensure a 90-degree phase differential between the two signals. The two signals are then routed to their respective HPAs, coherently combined in an output hybrid, and routed to an antenna.

k. The diplexer combiner is used to combine the outputs of two HPAs operating at different frequencies. There is a 40-MHz narrowband port that requires tuning to the operating frequency and a 500-MHz wideband port that accepts any signal within the 7.9- to 8.4-GHz range with the exception of the frequency tuned in on the narrow band antenna. The power output of each RF signal is equal to the input power minus the path losses.

l. Within the transmit section of the AN/TSC-100A there are 11 possible transmit configurations, each one providing the system with different capabilities. These 11 configurations are as follows:

(1) HPA #1 to Antenna #1, HPA #2 to Antenna #2.

(2) HPA #1 to Antenna #1, HPA #2 to Dummy Load #2.

(3) HPA #1 to Dummy Load #1, HPA #2 to Antenna #2.

(4) HPA #1 to Antenna #2, HPA #2 to Antenna #1.

(5) HPA #1 to Dummy Load #2, HPA #2 to Dummy Load #1.

(6) HPA #1 to Antenna #2, HPA #2 to Dummy Load #1.

(7) HPA #1 to Dummy Load #1, HPA #2 to Dummy Load #2.

(8) HPA #1 and HPA #2 Diplexed to Antenna #2.

(9) HPA # 1 and HPA #2 Diplexed to Dummy Load #2.

(10) HPA #1 and HPA #2 Coherently Combined to Dummy Load #1.

(11) HPA #1 and HPA #2 Coherently combined to Antenna #2.

m. The receiver group accepts an RF signal in the 7.25- to 7.75-GHz range from the antenna group and amplifies and translates it to a 70-MHz IF signal for application to the modem group.

n. The major end-items in the AN/TSC-100A(V)1 and (V)2 are shown in Table D-A-E-2.

3. Antenna. The AN/TSC-100A can use either an 8-foot or a 20-foot antenna. The characteristics of the antennas are found in Table D-A-E-1.

4. Baseband Multiplexer Equipment. The multiplexer group provides the interface between external analog and digital signals and the modem group.

a. TD-1337 (TSSP)

(1) The TSSP combines inputs from the LRMs, CDϕ groups, 16-Kbps orderwire, and encrypted CESE data (2 Kbps) into a composite signal. The composite data rate for the TD-1337(V)3 used in the AN/TSC-100A ranges from 16 to 4,632 in 8-Kbps increments.

Table D-A-E-2. AN/TSC-100A(V) Major Equipment Items

Nomenclature	(V)1	(V)2
Multiplexer Group/Baseband Equipment		
TD-1389(V) (LRM)	6	5
TD-1337 (TSSP)	2	2
KG-81	6	5
KG-84(V)	1	1
KY-58	2	2
MD-1026	1	1
Modem Group		
MD-1131, Digital Data Modem	2	1
OX-64, Coder Group	2	1
MD-1132, Digital Data Modem	2	1
Transmit Group		
C-11375	1	1
Coherent Combiner	1	1
AM-6703, HPA	2	2
PP-7087, HVPS	2	2
CV-3198B, Upconverter	4	4
OA-9213, Diplex/ Combiner	1	1
Receive Group		
AM-7227, LNA	4	4
CV-3210B, Downconverter	7	6
C-11109A	2	2
LNA BITE Unit	2	2
Wideband Preselector	1	1
SHF Power Divider	2	2
Antenna Group		
AS-3036, 8-ft Antenna	1	1
OE-361, 20-ft QRSA	1	1
C-10273, DSCSU	2	2
C-10817, RCU	2	2

(2) The TSSP monitors 56 CESE status points, formats them into a block message, and applies it to a KG-84( ) as 150 bps CESE data. The

KG-84( ) encrypts the data and returns as 2-Kbps CESE encrypted data. The characteristics and setup for the TSSP are covered in Annex A.

b. TD-1389 Low Rate Multiplexer. The LRM is an ATDM that multiplexes up to 12 full-duplex data channels. The input data rates vary from 37.5 bps to 56 Kbps depending on the application. The composite output rate is the sum of the input rates plus overhead and cannot exceed 256 Kbps. The LRM accepts single channel digital, FSK, or analog voice inputs. It can also accept a conditioned diphase group input at 256 Kbps or less. The LRM is the primary user interface device for the AJCM. When operating with the AJCM, the maximum allowable LRM composite group rate is 32 Kbps. The LRM characteristics and operation are covered in Annex A.

c. KG-81 (TED). The TED provides full duplex digital data encryption/decryption for the transmit/receive signal from the LRM.

d. KG-84(V) (GPEE). The KG-84(V) encrypts information messages that pertain to the status of the terminal. The TSSP accumulates this status information, sends it to the KG-84(V) for encryption, and receives this status information back for transmission.

e. KY-58 VINSON. The KY-58 VINSON is a secure voice unit that digitizes and encrypts the audio input signal into a 16-Kbps data stream.

5. Modem Equipment. The modem group provides the interface between the baseband multiplex equipment and the transmit and receive equipment. It consists of the MD-945 digital data modem, the AJCM SAW filter units, and the modem interface assembly.

a. MD-945 Digital Data Modem. The MD-945 modem provides an unbalanced NRZ interface for operation with the TSSP. The MD-945 modem can be configured to use either BPSK or quadrature phase shift keying (QPSK) modulation techniques. Using BPSK modulation, the modem can operate at data rates ranging from 16 Kbps to 2.499 Mbps. If the modem is configured for QPSK operation the data rates range from 100 Kbps to 4.0 Mbps. The modem is normally configured to use QPSK modulation.

b. Nodal Terminal Antijam Control Modem. The NT AJCM consists of the MD-1131 control modem, MD-1132 communications unit, and the OX-64 10-channel TRANSEC unit. The NT AJCM is a processor controlled, spread spectrum modem that provides up to four full-duplex, secure, jam-resistant communications links over a GMF satellite system. User interfaces to the AJCM are provided by the LRM (up to four) or by up to four single-channel, 75-Kbps teletype circuits directly connected to the AJCM from the VF-/data entry panel. If the LRM is used as the user interface, the AJCM is connected to the composite group port of the LRM. The LRM composite group rates can range from 75 bps to 32 Kbps. The output of the AJCM is a spread spectrum pseudorandom noise (PN) modulated 70-MHz IF signal.

6. Interfaces. All user circuits pass through either the TD-1337(V)3 or the AJCM. Circuits transiting the TSSP may or may not pass through the LRMs. Annex A and Annex F provide a full description of the TD-1337 and the AJCM and the limitations on inputs passing through them. Figure D-A-E-2 depicts the baseband equipment connectivity. There are no two-wire to four-wire converters or signaling converters in the AN/TSC-100A. If this equipment is needed, it must be provided externally. The typical interfaces to the AN/TSC-1OOA are discussed in subparagraphs 6a thorough 6f below.

a. Direct TD-1337 Conditioned Diphase Input. This is a direct input to the TD-1337 using CX-11230 cable. The CDϕ signal enters the AN/TSC-100A via the VF/Data/Signal Entry Panel. Data rates can be 72, 128, 144, 256, 288, 512, 576, 1,024, or 1,152 Kbps. For data rates greater than 576 Kbps, two TSSP ports must be strapped together. The TEDs cannot be used to encrypt this group.

b. Group Input Through the MD-1026. This input may be either CDϕ or dipulse signal (depending on the card in the group modem). CDϕ group data rates can be 72, 128, 144, 256, 288, 512, 576, 1,024, or 1,152 Kbps. The maximum lineside transmission distance for these groups is 2 miles for data rates up to 576 Kbps and 1 mile for 1,024 and 1,152 Kbps. Dipulse group data rates can be 288, 576, or 1,152 Kbps. The maximum lineside transmission distance for dipulse signals is 1 mile. For data rates over 576 Kbps, two TSSP ports must be strapped together. The TEDs cannot be used to encrypt these groups.

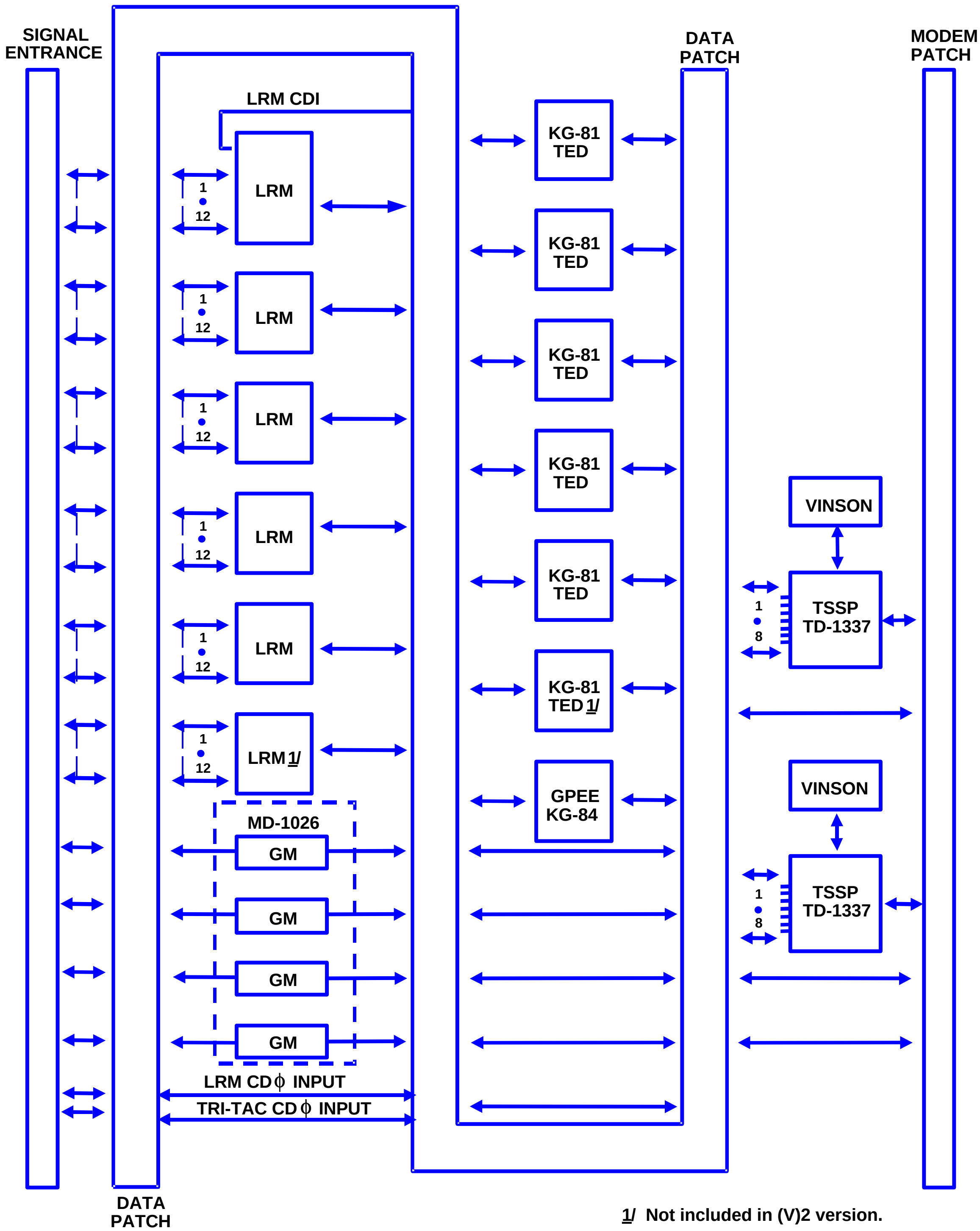

Figure D-A-E-2. AN/TSC-100A Baseband Configuration

c. Individual Channel Connections Through the TD-1389 LRM. These interfaces may be analog, FSK, CDϕ, or NRZ data. See Annex A for the limitations on each type of input. The physical interface is provided by 26-pair cable hocks and/or by binding post connectors located on the VF/data entry panel. Both the data and the timing 26-pair cables are paralleled with the binding post connectors. The AN/TSC 100A(V)2 has five LRMs with a maximum of 60 inputs. The composite group output from the LRM may be connected to the TSSP or the AJCM. The LRM provides the primary user interface to the AJCM.

d. Group Input Through the TD-1389 LRM. This configuration allows one CDϕ group to interface with the TSSP through LRM number one. The physical interface is CX-11230 cable. The LRM must be configured for GM mode of operation. The maximum allowable data rate is 256 Kbps. (See Annex A.)

e. 70 MHz IF. There are two separate 70-MHz, 50-ohm inputs for the transmit and receive IF.

f. AJCM Teletype Interface. This is a direct interface to the AJCM via binding post connectors on the VF/data entry panel. The AJCM can support up to four TTY interfaces in lieu of the LRM interfaces.

7. Orderwire. The AN/TSC-100A incorporates several different orderwire capabilities. (See Appendix B to Enclosure A.) A 16-Kbps digital voice orderwire is built into each TSSP. This orderwire may be secured by a KY-58 VINSON or operated nonsecure. Another orderwire capability exists through a receiver-transmitter orderwire RT-1287/TSC that interfaces with the MD-945 modem. This nonsecure audio orderwire is used for coordination and control purposes with the control terminals and other network terminals. The AN/TSC-100A has two RT-1287s. There is also an interface on each TSSP for a user-supplied ANDVT orderwire. The shelter is also equipped with a TA-312 analog telephone. This instrument may be used for local coordination.

8. Patching. Patch panels are provided in the AN/TSC-100A terminal to isolate equipment groups and facilitate the interconnections of system components to form various configurations. There are six patch panels within the terminal: data, modem, orderwire, IF, SHF, and the SHF

track. All baseband signals, as well as the LRM composite baseband signals, appear at the data patch panel. The composite baseband signal for the TSSP appears at the modem patch panel. The IF patch panel is the interface point at 70 MHz between the modem and transmit/receive groups. An orderwire patch panel is used to interface the FM orderwire with the MD-945 Modem. At the transmit RF level, the SHF patch panel is used to interface the upconverters, amplifier/mixers, and HPAs. To interface the outputs of the SHF divider to the downconverters, an SHF track patch panel is used.

9. Signal Entry. All user signals entering and leaving the terminal pass through two entry panels located on the shelter walls. These signal entry panels are the VF/data/signal entry panel and the VF/data entry panel.

a. VF/Data/Signal Entry Panel. The VF/data/signal entry panel is the interface point for the TRI-TAC group inputs/outputs, field telephone, external 5-MHz input, 70-MHz transmit and receive monitors points, and 36 of 72 LRM local subscriber data and timing inputs/outputs.

b. VF/Data Entry Panel. The VF/data entry panel is another interface point for the LRM local subscriber inputs/outputs. A total of 36 local subscriber accesses appear here. Terminal interface is by 26-pair hock connector or binding post connectors. These connectors are in parallel to enable access by either means. The VF/data entry panel also provides access to the AJCM 75 bps TTY interfaces via binding post connectors.

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ANNEX F TO APPENDIX A TO ENCLOSURE D

GMF SATELLITE AJCM

1. Introduction

a. Planning tactical satellite systems using AJ configured GMF satellite terminals requires a basic understanding of the AJCM installed in the GMF Phase II satellite terminals. It is equally important to understand that the purpose of the AJCM is to provide AJ protected communications to a limited number of "critical" users. AJ protection is accomplished by diverting all of the GMF terminal output power to the greatly reduced data rate (32-Kbps max) of the AJCM. Although the AJCM maximum data rate is 32 Kbps, typical data rates used will probably be 3 Kbps or less, depending on the jamming scenario.

b. This appendix provides a description of the AJCM family of modems. It also discusses planning factors that must be considered when planning satellite transmission systems utilizing AJ equipped GMF terminals. An AJCM crew assignment sheet and a set of instructions are provided in Appendix D to Enclosure A.

c. An RF power monitor will be installed in all GMF terminals. This monitor provides a reportback system to allow continuous monitoring of each network ground satellite terminal by the network control terminal. A dedicated power monitor in each network interfaces the polling channel of the AJ modem through a 9,600 baud data bus.

2. Antijam/Control Modem

a. The AJCM is a family of processor controlled, direct sequence, spread spectrum modems developed to provide a full duplex, secure, jam-resistant communications link over a GMF satellite system. On the transmit side, the AJ modem accepts digital data from the user at rates from 75 bps to 32 Kbps. It spreads the data over a 40-MHz bandwidth using a 20-MHz PN digital code sequence. The spread spectrum signal is then modulated onto a 70-MHz carrier for transmission. The data are transmitted at or near the noise level because the transmit data power level is not spread over a 40-MHz bandwidth.

b. On the receive side, the spread spectrum signal is demodulated from the 70-MHz carrier. The signal is then "despread" by matching it with the same PN digital sequence code used by the transmitting terminal. When the two signals are matched, the spread spectrum signal collapses to its original bandwidth (75 bps to 32 Kbps). Figure D-A-F-1 illustrates spread spectrum modulation.

3. Modem Types. There are three types of AJ modems in the AJCM equipment family: nodal, nonnodal, and network control. Each modem consists of a different combination of the components listed in subparagraph 4a.

a. Nonnodal Terminal Modem. The NNT modem is used in the AN/TSC-93B and AN/TSC-94A GMF terminals. The NNT modem consists of the MD-1131 control modem and the OX-63 coder group (four-channel TRANSEC unit) (see Figure D-A-F-2). The NNT modem provides the capability for one CCC and one COMM link (COMM 1). The COMM link can be set up as an LCC (user traffic) or VCC (VOW). The VCC cannot be supported in a jamming environment.

b. Nodal Terminal Modem. The NT modem is used in the AN/TSC-85B and AN/TSC-100A GMF terminals. The NT modem consists of the MD-1131 CM, the MD-1132 COMM unit, and the OX-64 10-channel TRANSEC unit (see Figure D-A-F-3). The NT modem provides the capability for one CCC and up to four COMM links. The CCC and COMM 1 are provided by the MD-1131 CM. COMM 2 through COMM 4 are provided by the MD-1132 COMM unit.

c. Network Control Terminal Modem. The NCT modem is used in the AN/MSQ-114 and AN/FSQ-124 network control facilities. The NCT modem consists of the MD-1133 network control modem and the OX-63 group.

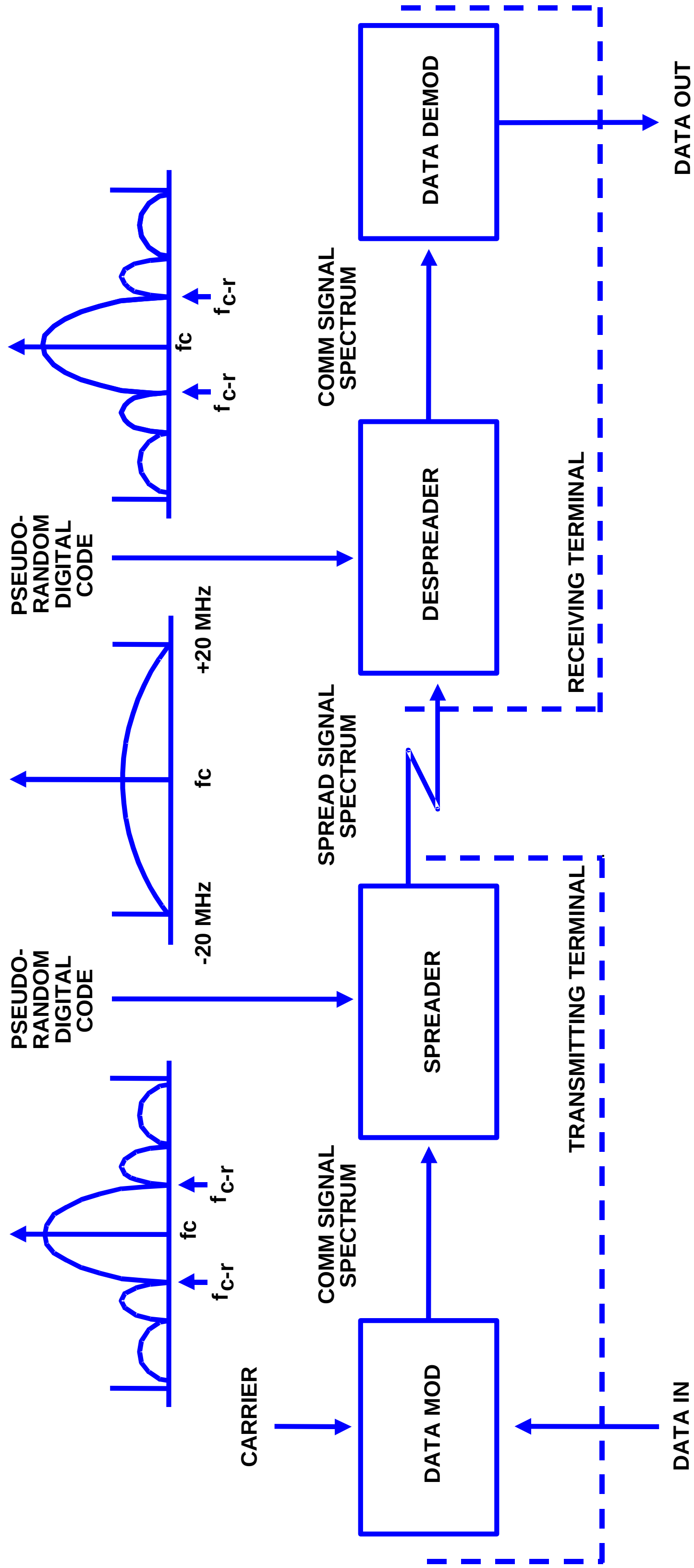
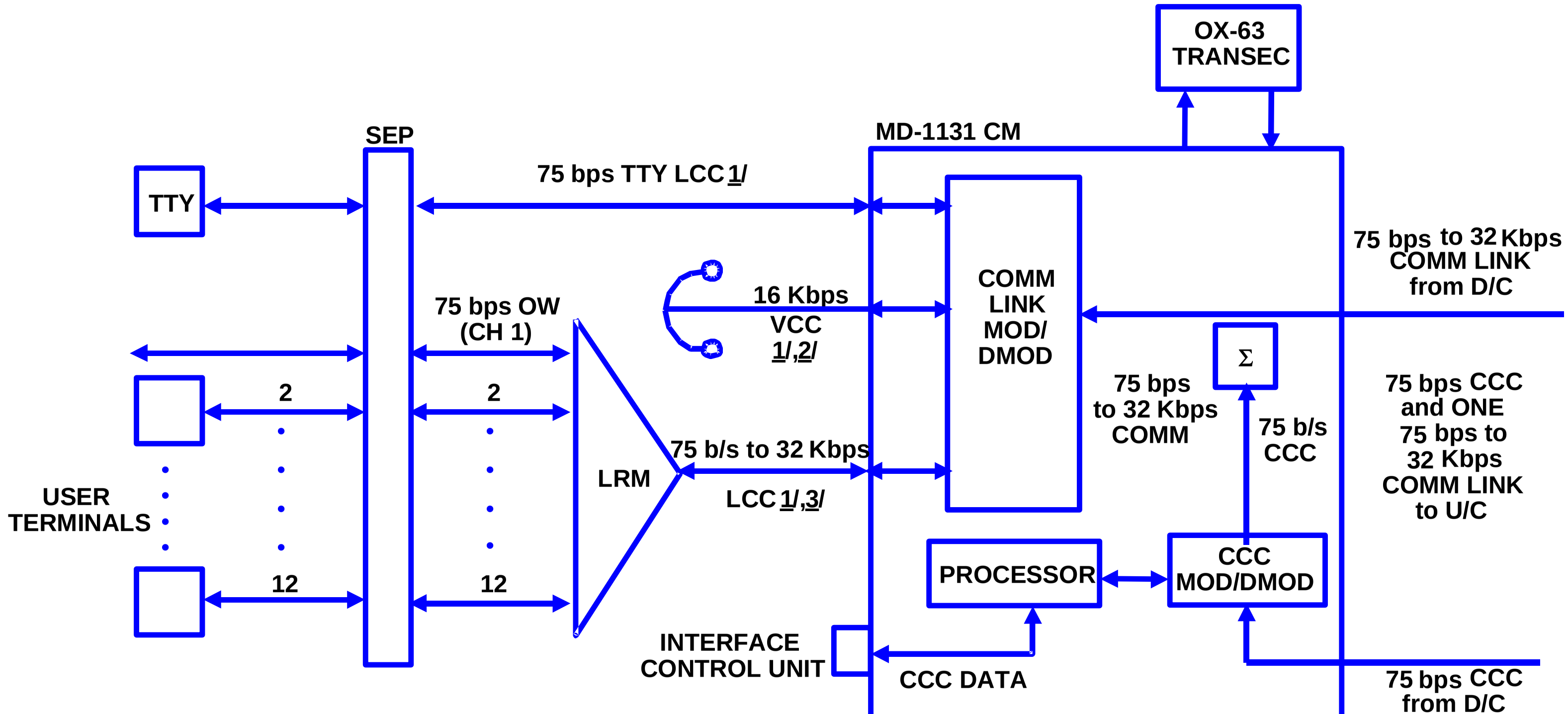


Figure D-A-F-1. Spread Spectrum Modulation Block Diagram

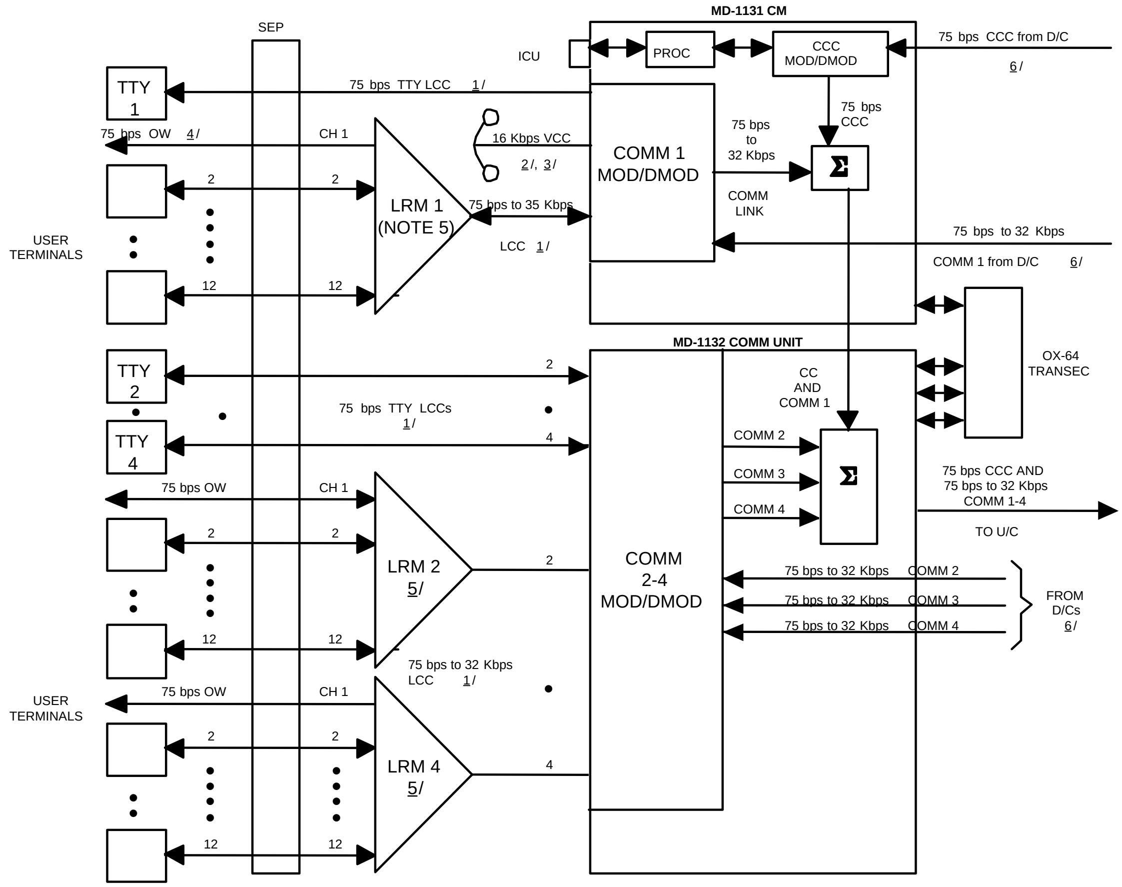


1/ The NNT AJCM can support one 75 bps TTY LCC or one 75 bps to 32 Kbps digital data LCC or one 16 Kbps VCC per COMM link. The NNT AJCM can support only one COMM link.

2/ The VCC cannot be extended outside of the GMF terminal.

3/ Includes a 75 bps orderwire on LRM Channel 1.

Figure D-A-F-2. (NNT) AJCM System



1/ The NT AJCM can support one 75 bps to 32-Kbps digital data LCC or one 16 Kbps VCC per COMM link. The NT AJCM can support up to four COMM links.

2/ Only one COMM link can be configured as a VCC at a time; i.e., if COMM 1 is configured as a VCC COMM 2, 3, and 4 cannot be configured as VCC.

3/ The VCC cannot be extended outside of the GMF terminal.

4/ Channel 1 of each LRM will be configured as a 75-bps orderwire.

5/ The NT AJCM requires the use of up to four TD-1389 LRMs.

6/ The AJCM requires the use of up to five downconverters (D/C), one for each CCC and one for each COMM link.

Figure D-A-F-3. NT AJCM System

4. AJCM Components. The AJCM family of equipment consists of the following components:

a. MD-1131 CM. Figure D-A-F-4 is a block diagram of the CM. The CM is a component of both the NT and NNT modems and provides the following major functions:

(1) Processor Function. The processor controls the operation of NT and NNT modem hardware. It provides data processing for the acquisition and maintenance of the network CCC and the COMM (user data) circuit(s) or the VOW VCC circuit. In the NT modem configuration, the processor also controls the MD-1132 COMM unit.

(2) Frequency Synthesis Function. The frequency synthesis function provides all of the frequencies and clocks required by the AJCM. The 5-MHz reference frequency used by the synthesizer to produce the clocks and frequencies is provided by the terminal U/C.

(3) CCC Modulation Function. The CCC modulation function provides the terminal U/C (NNT configuration) or the MD-1132 COMM unit (NT configuration) with a spread spectrum CCC transmit signal. The modulator accepts 75-bps baseband CCC data.

(4) COMM Link Modulation Function. The COMM link modulation function provides the terminal U/C or the MD-1132 COMM unit with a spread spectrum COMM link signal. The modulator accepts 75-bps to 32-Kbps user data from the TD-1389 LRM or 16-Kbps VOW data from front panel VOW handset interface. The COMM link modulator is identical in operation to the CCC modulator (see subparagraph (3) above).

(5) Beacon/CCC Demodulation Function. The BCN/CCC demodulation function is used to demodulate a 70-MHz IF signal from a specific terminal D/C. The demodulator can be configured by the processor to acquire and track the satellite beacon, a pseudobeacon provided by the NCT, or the CCC signal transmitted by the NCT. The satellite BCN signal provides the processor with frequency and time information necessary to establish the CCC or COMM link. If the satellite beacon is not available, the NCT

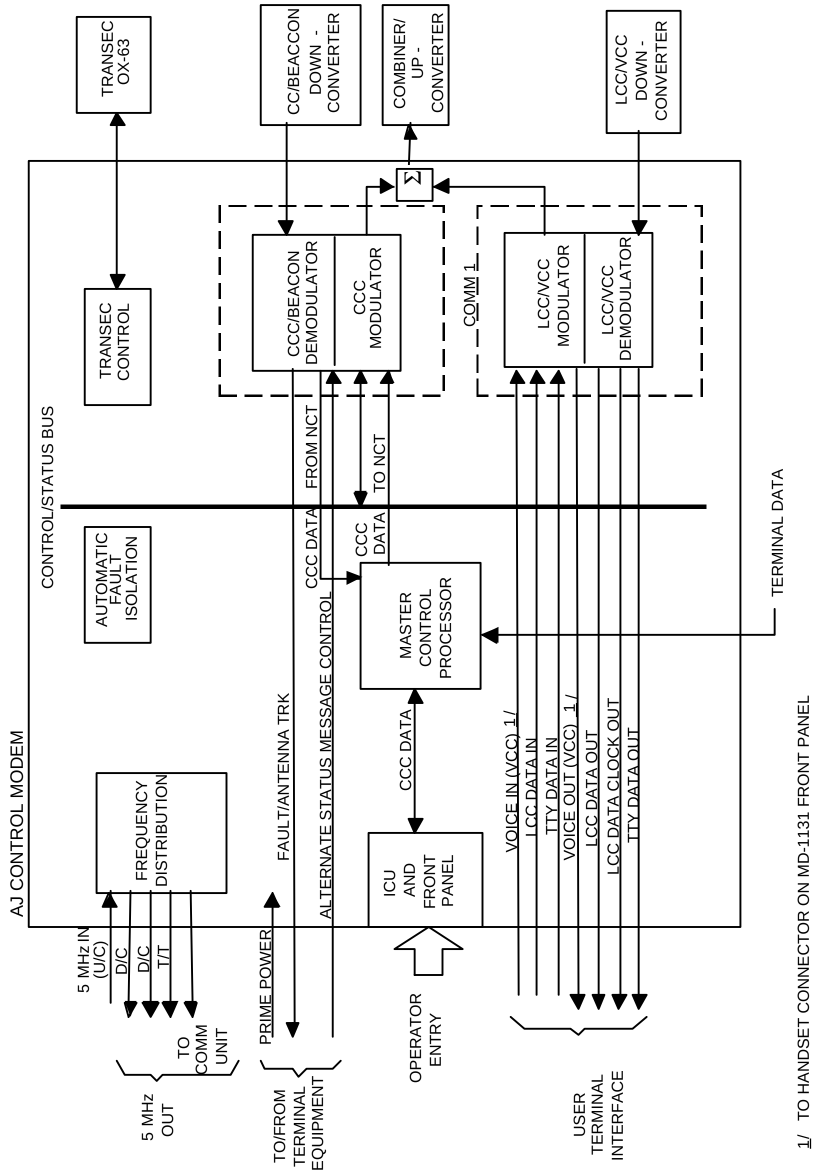


Figure D-A-F-4. MD-1131 Control Modem Functional Block Diagram pseudobeacon provides essentially the same information to the processor as the BCN signal. Once the CCC is established, the BCN or pseudobeacon signal is no longer required. The demodulated CCC signal provides network command and control instructions to the processor.

(6) COMM Link Demodulation Function. The COMM link demodulation function is used to demodulate a 70-MHz IF signal from a terminal D/C. The received IF signal is despread using a PN sequence code identical to the one used at the transmit end.

(7) Man/Machine Interface. The MMI function provides the operator with the capability to monitor and control the AJCM. The processor controlled MMI formats and sequences data to/from the processor to the operator.

(8) Internal Switches. The MD-1131 CM has two dip switches mounted on the front panel interface CCA. The switches are used to set initial network deployment configurations. The switches allow the operator to set the unique terminal ID code and the NCT ID code. They also allow the operator to select the real-time mode (RTM) for CCC acquisition. The switches are accessible by removing the top cover and must be set before applying power to the AJCM.

b. MD-1132 COMM Unit. The COMM unit is a component of the NT AJCM only. It provides the capability to modulate and demodulate three COMM links (COMM 2 through COMM 1). Figure D-A-F-5 provides a block diagram of the COMM unit.

c. OX-63 Coder Group. The OX-63 is a four-channel TRANSEC unit used with the NNT and NCT AJ modems. It consists of two TRANSEC interface cards, a TRANSEC control card, and four KGV-9 TRANSEC modules. In the NNT the TRANSEC unit provides security for the CCC and COMM link. In the NCT it provides security for the CCC. Each signal requires two KGV-9 modules: one for transmit and one for receive.

d. OX-64 Coder Group. The OX-64 is a 10-channel TRANSEC unit used with the NT AJ modem. It contains 10 KGV-9 modules and provides security for the CCC and four COMM links.

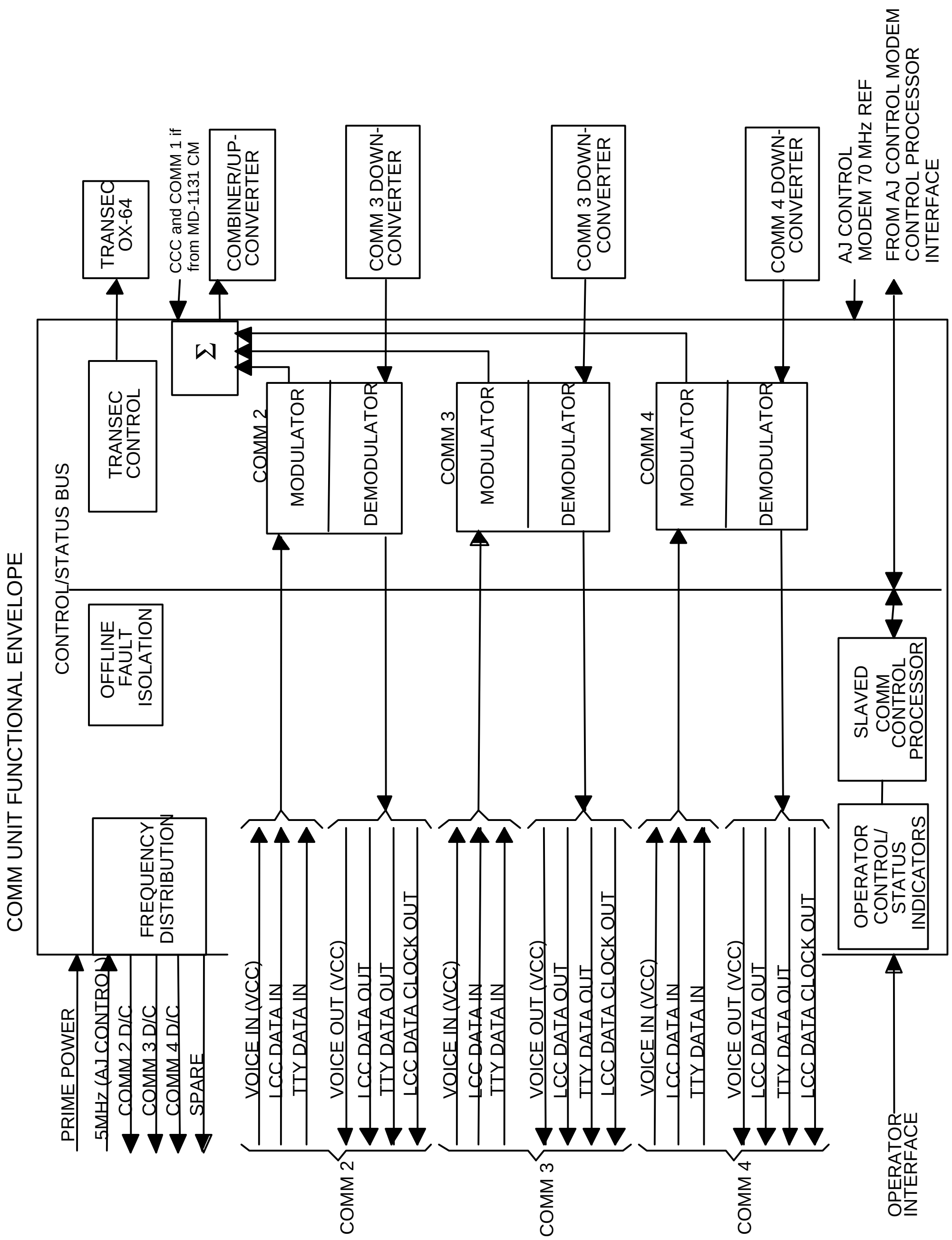


Figure D-A-F-5. MD-1132 COMM Unit Functional Block Diagram

5. AJCM Communications Functions. The AJCM provides two major communications circuit functions: CCC and a COMM link. The COMM circuit can be either an LCC or a VCC.

a. CCC. The CCC is a processor-controlled, AJ-protected, full-duplex, 75-bps digital data circuit. It is used by the network terminal (NCT) to transmit acquisition and control data to the NT and NNT. The CCC is also used to provide NT and NNT terminal status to the NCT. The CCC is normally always present as a component of the AJCM spread spectrum signal.

b. Link Communications Circuit. During jamming the AJCM provides the capability for a full-duplex, AJ-protected data communications circuit between two GMF satellite terminals. The LCC is used to pass user traffic over the satellite link. The LCC data rate can range from 75 bps to 32 Kbps depending on the severity of the jamming. At the 32-Kbps rate, the LCC can support up to 12 low-data rate (2.4 Kbps or less) user circuits. The LCC is also known as the COMM link. Depending on the type, the AJCM can provide either one or up to four COMM links (see Figures D-A-F-2 and D-A-F-3.)

c. Voice Communications Circuit. The VCC provides a 16 Kbps VOW capability for use by terminal operators. The VCC is supported only during periods when jamming is not present. The VCC can be provided in lieu of the LCC; i.e., a VCC and an LCC cannot be provided simultaneously over the same COMM link. Additionally, the VCC cannot be extended outside of the GMF terminal.

6. User Interfaces. The AJCM provides three types of user interfaces: digital data, 75-bps TTY, and VOW. The NNT modem can provide one digital data LCC (75 bps to 32 Kbps), one 75 bps TTY LCC, or one 16-Kbps VOW VCC. The NT modem can provide up to four digital data or TTY LCCs or a combination of digital data and TTY LCCs or one VCC and up to three LCCS. Table D-A-F-1 lists the characteristics of the user interfaces.

Table D-A-F-1. AJCM Technical Interface Characteristics

Characteristic	Value
MD-1131 Control Modem	
Satellite-Side Interfaces	
Transmit/Receive IF Frequency	70 MHz
Spectrum Bandwidth	40 MHz
Modulation	Pseudonoise (PN)
Modulation Rate	20 MHz
Earth-Side Interfaces	
Link Communications Circuit	
Digital Data	75 bps to 32 Kbps
	Balanced/Unbalanced
	NRZ or CDϕ
TTY	75 bps balanced NRZ
	10 or 11 bit start/stop ASC II
Voice Communications Circuit	
Input/Output	Analog
A/D, D/A Conversion	CVSD
Data Rate	16 Kbps
MD-1132 Communications Unit	
Satellite-Side Interfaces	
Same as MD-1131	
Earth-Side Interfaces	
Link Communications Unit	
Digital Data	75 bps to 32 balanced/unbalanced NRZ or CDϕ
TTY	75 bps balanced NRZ 10 or 11 bit start/stop ASCII

a. Digital Data LCC Interface. The digital data interface is a 75-bps to 32-Kbps balanced or unbalanced digital baseband NRZ or CDϕ interface. All digital data LCCs are initially established at 75 bps; after that the data rate can be changed to the rate specified in the AJCM crew assignment sheet. User access to this interface is via the TD-1389 LRM.

b. Teletype LCC Interface. The AJCM also provides a 75-bps, asynchronous, balanced NRZ interface. This interface can be used in lieu of the digital data interface. User access to this interface is via external pushpin connectors on the data entry panel (AN/TSC-85B and AN/TSC-93B) and the VF/data entry panel (AN/TSC-94A and AN/TSC-100A).

c. Voice Orderwire VCC Interface. The AJCM provides the capability for a 16-Kbps digital voice orderwire VCC interface. This interface can be used in lieu of the LCC interface. Access to the VOW VCC interface is via a six-pin handset connector on the front panel of the MD-1131 CM. The VCC interface can only be used by the GMF satellite terminal operator as it cannot be extended outside of the terminal.

7. AJ Communications Service. AJ user communication service is provided through the establishment of LCCs. User access to each LCC is provided either by direct connection of one TTY, conditioned diphase, or balanced NRZ signal directly to the LCC or by connection of one or more user signals to a dedicated LRM connected to the LCC. The use of the LRM is recommended, as it provides more flexibility in user interface options.

a. LRM Interface. The composite output of the LRM forms the input to one AJ COMM link (LCC). Four ranges of LRM composite data rates have been established for use with the AJCM. The data rate in use at any particular time during the mission depends on the level of jamming encountered and the countermeasure directed by the GMF network controller. The data-rate classifications are emergency bypass data rate (75 bps); minimum data rate (166 bps); basic data rate (up to 3 Kbps); and high data rate (up to 32 Kbps). Guidelines for planning user service for the AJCM are provided in the following subparagraphs.

(1) Emergency Bypass Data Rate (75 bps). The emergency bypass data rate will be used only in the presence of jamming at a level sufficient to preclude operation at any other rate. Channel 1 of the LRM, that is the emergency bypass channel, should be configured to support a 75-bps TTY circuit. When operating at the emergency bypass data rate, this channel is used as required for technical control orderwire communications or as the most critical user circuit.

(2) <u>Minimum Data Rate (166 bps)</u>. These data are normally used only in the presence of jamming at a level sufficient to preclude operation at the basic data rate. User service is provided as follows:

(a) A 75-bps TTY connected to LRM Channel 1 as described in subparagraph 7a(1) and used as a technical control orderwire.

(b) A 75-bps TTY connected to a second LRM channel and designated the most critical user circuit.

(3) <u>Basic Data Rate (Up to 3 Kbps)</u>. The basic data rate is used during normal (unstressed) network operation. In the event of jamming, countermeasures aimed at maintaining the basic data rate (to the extent possible) will be directed by the GMF network controller. User service is provided as follows:

(a) The two 75-bps TTY circuits described in subparagraph 7a(2).

(b) Additional critical circuits as required by the user; the number of circuits and the data rates must be limited such that the LRM composite data rate does not exceed 3 Kbps.

(4) <u>High Data Rate (Up to 32 Kbps)</u>. The high data rate is used only in the presence of nuisance jamming to allow maximum utilization of the SATCOM terminal. User service is provided as follows:

(a) Two TTY circuits and critical user circuits as described in subparagraph 7a(3).

(b) Additional high-priority circuits as required by the user; the number of circuits and the data rates must be limited so that the LRM composite data rate does not exceed 32 Kbps.

b. <u>TTY Interface</u>. This interface provides the capability for a single AJ protected 75-bps teletype circuit per LCC. If this interface is selected, the LRM cannot be used and only one critical user can be supported. Because of the lack of flexibility; i.e., provides only one circuit per LCC, use of the AJCM TTY interface is not recommended.

8. AJCM Modes of Operation

a. CCC Acquisition Modes. The AJCM is capable of three modes of CCC acquisition: Mode 1 (beacon aided CCC acquisition), Mode 2 (pseudobeacon CCC acquisition), and Mode 3 (RTM CCC acquisition). The CCC acquisition modes are used for initialization and entry into the network. The mode used will be determined by the GMF manager.

(1) Beacon Aided CCC Acquisition. The primary method for CCC acquisition is Mode 1 or beacon aided acquisition. In this mode, the NCT, NTs, and NNTs use the DSCS satellite beacon signal as the means to initialize and enter the network. The DSCS satellite beacon signal (more specifically the satellite's 5-MHz oscillator) becomes the network's master reference frequency and timing source.

(2) Pseudobeacon CCC Acquisition. This acquisition mode is for use in the event that the satellite beacon is not present or is being jammed. In this mode, the satellite beacon is replaced by a pseudobeacon signal generated by the NCT. The pseudobeacon signal emulates the PN sequence and code phase of the original satellite beacon signal. However, the pseudobeacon signal is not broadcast on the original satellite beacon carrier frequency, but is superimposed on the NCT CCC transmit carrier frequency. In this mode the NCT's rubidium standard provides the 5-MHz master reference frequency and timing source for the network.

(3) Real-Time Mode CCC Acquisition. The CCC can be acquired using the RTM. If this mode is used, the RTM switch inside the modem must be set prior to applying power to the AJCM. The RTM requires the use of a local beacon generator that must be time-aligned with a local beacon generator at the NCT. The local beacon generator provides the AJCM with a 5-MHz reference frequency and a timing reference for the modem PN sequence.

b. COMM Link Acquisition. The AJCM is capable of four modes of LCC acquisition. The LCC acquisition modes are listed in the order of preference. The planner is primarily concerned with CCC aided COMM link acquisition. The remaining three modes are used only if the CCC is not available.

(1) CCC aided.

(2) Beacon aided with ephemeris data.

(3) Beacon aided without ephemeris data.

(4) Alternate acquisition.

9. AJCM Planning Considerations. The demand for DSCS satellite access, even in an unstressed environment, generally exceeds the capacity of satellites currently available for use. This factor makes detailed planning of the GMF satellite portion of tactical transmission systems an absolute necessity. Implementation of the AJCM into the GMF terminals further complicates the planner's job and makes the concept of centralized planning even more desirable. Using the information in Appendix A and Annexes A through E and the crew assignment sheets in Appendix D to Enclosure A, broad overall planning for an AJ-protected tactical satellite transmission system can be done. The advent of the AJCM requires that the planner take a number of factors into consideration over and above those factors involved in planning an unprotected system. These factors are listed below.

a. Critical User Communications. The AJCM provides AJ protected critical user communications and is online whether or not jamming is present. The planner must determine the best way to maximize the use of the limited data rates available for AJ protected communications circuits. The planner must:

(1) Determine the number of critical users at each node in the system.

(2) Determine and specify the data rate required to support critical user circuits at each GMF terminal in the system. If possible the basic data rate should be used. Specify the high data rate if the planner determines that (a) if jamming is present, it will be light and (b) high data rate operation is essential to mission success.

(3) Determine the most critical user based on user input to the planning cycle. Current AJ concepts call for the most critical user to be

assigned to one of the two TD-1389 LRM channels supportable by the minimum data rate. The minimum data rate is the most survivable in the presence of jamming.

b. <u>GMF Terminal Remoting</u>. Remoting an AJCM-equipped AN/TSC-85B or AN/TSC-100A away from the operations node requires additional multiplexing equipment to be located at both the operations node and the GMF terminal or the use of CX-4566 26-pair cable. The additional equipment is required because up to eight digital groups (four AJ protected groups and four unprotected groups) are required between the node and the GMF terminal.

c. <u>User Data Rates</u>. Data rates for user circuits traversing the AJ-protected transmission links are generally restricted to lower non-TRI-TAC data rates; i.e., 2.4 Kbps or less.

d. <u>Orderwire Circuits</u>. The current concept requires that channel 1 of each LRM used with the AJCM be configured as a 75-bps orderwire.

ANNEX G TO APPENDIX A TO ENCLOSURE D

AN/TSC-156 (V) 3/4/5
SHF TRI-BAND ADVANCED RANGE EXTENSION TERMINAL
(STAR-T)

1. Introduction

a. The AN/TSC-156(V)3/4/5 is being provided as part of the Tactical Tri-band Terminal (HMMWV) (T3(H)) program. This program combined the requirements of the US Army, USSOCOM, JCSE, and USMC. The basic requirements of these users are very similar and a great deal of common parts will be used. The configurations are different, and this has been identified in the T3(H) specification. The Army will use two primary configurations, the AN/TSC-156(V)3 standard nonswitch version (also used by the USMC and JCSE) and the AN/TSC-156(V)4/5 switch versions (also used by JCSE). USSOCOM will use the AN/TSC-156 (V)1 version exclusively. The AN/TSC-156(V)1/3/4/5 are triband, multichannel, tactical satellite communications terminals that operate within the SHF satellite spectrum over military X-Band and commercial C-and K_u band satellites. The terminals consist of an integrated pallet mounted assemblage, utilizing nondevelopmental item (NDI), COTS, and government furnished equipment (GFE). (See Figure D-A-G-1 and D-A-G-2.)

b. The Warfighter Information Network (WIN) architecture in conjunction with the Joint Technical Architecture will initiate a trend toward commonality with commercial switching and data standards to include end instruments. The AN/TSC-156(V)3/4/5 will be the lead system of the WIN and will start the transition to the WIN architecture. Therefore, these terminals will interface with existing legacy, military voice and data networks, as well as current and projected commercial voice and data switching systems.

c. The pallet will be crew removable, which will allow changing transport vehicles without the use of a wrecker. For operations, the pallet must be mounted on the transport vehicle. The transport vehicle for both versions will be two enhanced capacity vehicles (ECVs). Both versions will be capable of C-5/17/130/141 roll-on/roll-off without special preparation, and be transportable by land, sea, and rail. The palletized terminal (minus prime mover) will be capable of being sling loaded by a UH-60 aircraft. The terminal/vehicle combination will be single-point sling loaded by CH-47 and CH-53 (USMC) aircraft. The terminals have a 30-minute setup/teardown time with frequency band changes in no more than 10 minutes.

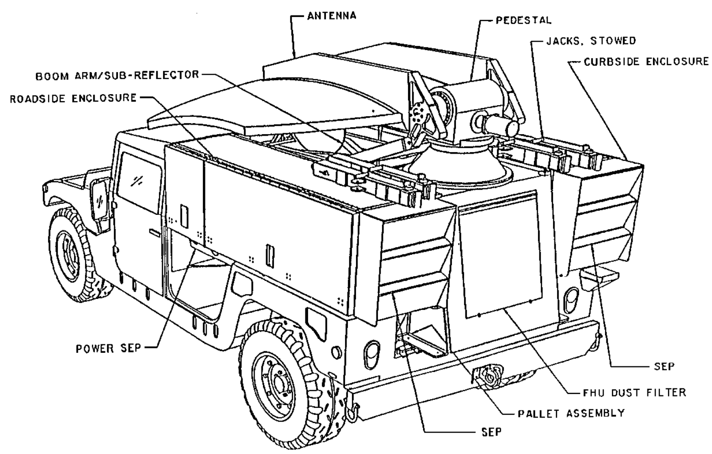


Figure D-A-G-1. AN/TSC-156(V)3/4/5 Palletized System Transport Vehicle

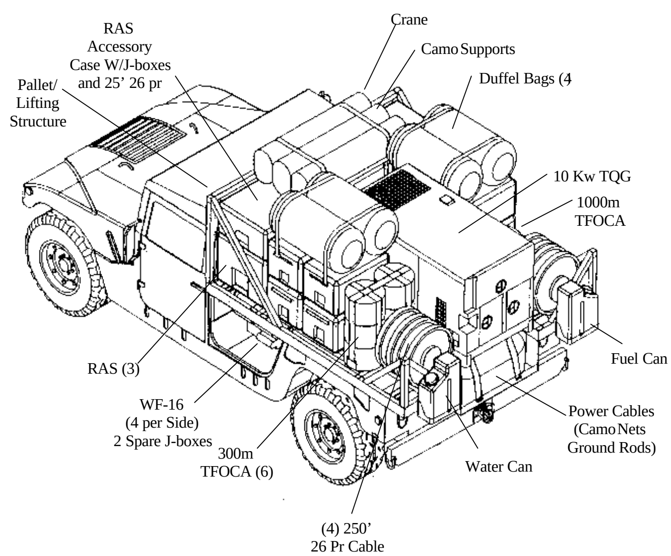


Figure D-A-G-2. AN/TSC-156(V)3/4/5 Palletized Mobile Power Unit (MPU) Transport Vehicle

d. Both versions will be capable of multinode operations with up to four full-duplex links in hub-spoke, mesh, or point-to-point modes. The USSOCOM Type 1 terminal will be capable of six full-duplex links in a hub-spoke, mesh, or point-to-point modes. A computer based control, monitor and alarm system known as the Operator Interface Workstation (OIW) will provide operator interface for ease of setup, operation, and maintenance. The OIW along with the appropriate orderwires will be remotable up to 500 meters via fiber-optic cable. The terminals are backward compatible with legacy AN/TSC-93B/85B TACSAT terminals to the second level multiplexer (TD-1337). Both versions will be capable of utilizing the Quick Reaction Satellite Antenna (QRSA) or AS-4429/TSC Lightweight High-Gain X-Band Antenna (LHGXA) as an external antenna to provide extra transmit and receive gain as mission needs dictate.

e. The terminals will provide variable, mission essential, military and commercial connectivity that includes data, imagery, video, and voice communications. They will transmit/receive at least four commercial T1/E1 transmission groups at 1.544/2.048 Mbps per group for a total aggregate data rate of 8.192 Mbps, plus data and voice orderwire(s). They will interface with a military Multiplexed Digital Transmission Group (MDTG) at 4096 Kbps and four-DTGs at data rates up to 1152 Kbps per DTG. Multiplexers, patching, and input ports will be provided to allow various types and combinations of military and commercial data rates, formats, and transmission groups/DTGs, to be combined to the maximum extent possible to utilize the total aggregate throughput. Voice and data compression techniques will be used to help conserve satellite bandwidth and power. Both versions will have redundant critical components, and onboard parts to maintain system operational availability rates. The redundant components will include the communications and control modem functions, OIW, up- and D/C, and transmitters. Multiplexer, baseband, and switch critical spares will also be carried.

f. The switch version will start the transition to commercially based switching standards to include group and loop requirements. To meet these requirements, the switch version will use a commercially based ISDN circuit switch with a wide array of interfaces and follow WIN circuit switch functional requirements. Two ECVs will transport the switch version. The first ECV transports the crew removable, pallet-mounted, system with integrated primary circuit switch and equipment to support at least 48 subscribers, seven X.25 and two 802.3 Local Area Network (LAN) connections.

g. There will be two switch versions to meet user requirements. The only difference in the versions is the amount of ancillary equipment that will be carried to terminate subscribers. The AN/TSC-156(V)4 is the light support (LS) version, which will be capable of terminating at least 140 subscribers. The AN/TSC-156(V)5 is the heavy support version, which will be capable of terminating at least 280 subscribers. (See Figure D-A-G-3.) The additional subscribers will be terminated using COTS remote access switches (RAS). The RAS will be mounted in transit cases with the switch, data, and environmental equipment, binding posts, J-box and cable connections.

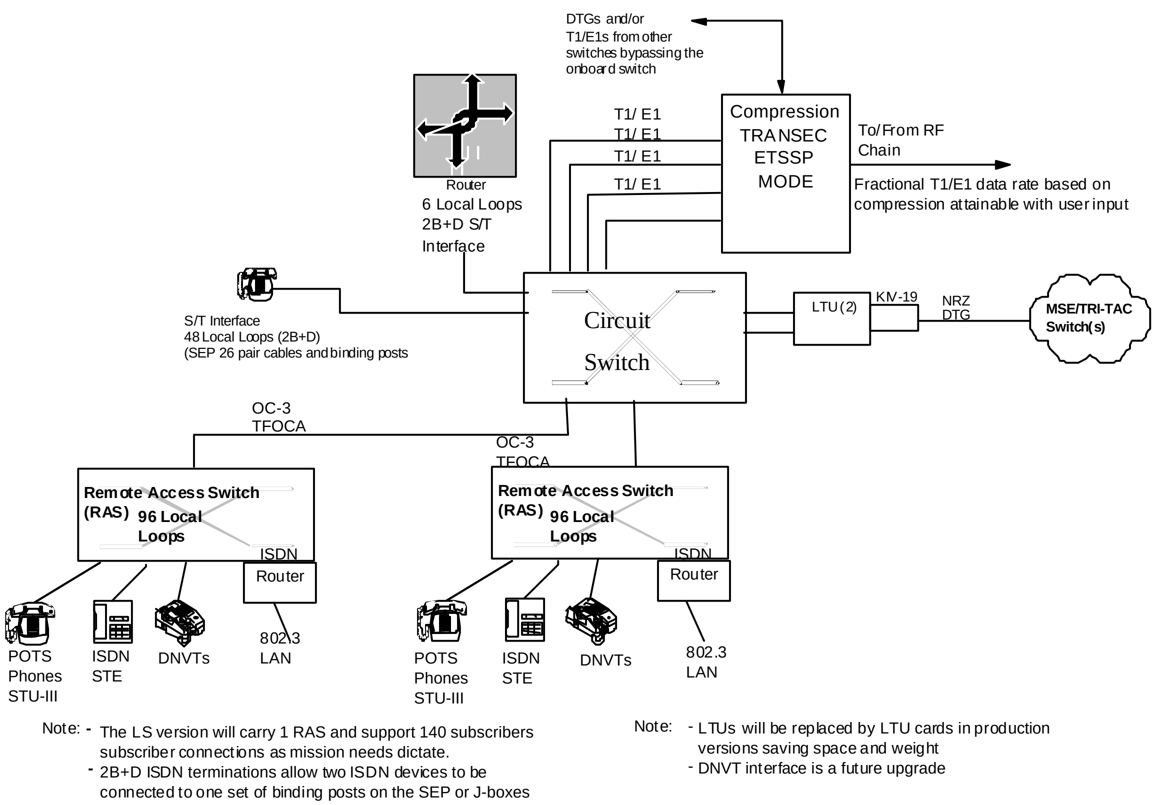


Figure D-A-G-3. AN/TSC-156(V)5 HS LAYOUT

h. The RASs are identical to the pallet-mounted primary switch, except it will be populated with user interface cards to terminate commercial and military end devices (DNVT (future upgrade), STE, STU-III, MMT 1500, ISDN, and analog telephones). The transit case will have a set of binding posts on it and connections for three J-1077 J-boxes. Using Basic Rate Interface (BRI) ISDN telephones, up to 96 subscribers can be terminated on one RAS. The RAS can be remoted up to 300 meters away from the vehicle via Tactical Fiber-Optic Cable Assembly (TFOCA).

2. Deployment. The AN/TSC-156(V)3/4/5 will satisfy the Army connectivity and switching requirements for the following.

a. Range extension for TRI-TAC and commercial systems at EAC and non-terrestrial communications connectivity to MSE between EAC and ECB. Extension includes connectivity to/from CONUS, or the sustaining base, and range extension augmentation for selected combat service support (CSS) elements, military intelligence (MI), and other high priority users as mission needs dictate.

b. Deployed Army Forces (ARFOR) support and Army contingency mission range extension requirements. The mission of the Power PAC3 Companies (PP3) is to support a deployed ARFOR headquarters and/or Army contingency deployments as mission needs dictate. In most deployments it will provide communications support for various deployed ARFOR headquarters during initial entry into a Theater. The PP3 Company would support a deployed ARFOR main, ARFOR FWD and up to six, liaison teams (LNO) that would be deployed to supporting headquarters (joint, allied, etc.).

c. Range extension and switch support for Army Forces Component to a CINC or JTF contingency operation or a major regional conflict (MRC). The mission of the Theater Tactical Signal Battalion (TTSB) is to provide nodal communications support for ARFOR components to a CINC or JTF contingency operation or an MRC. The terminals will provide switching capability and provide high-capacity, range extension, between selected EAC and MSE switches. Both versions will be used to provide connectivity to the CONUS/sustaining base as mission needs dictate. The terminals will operate in a mix of point-to-point and multinode configuration (hub spoke and mesh).

d. Range extension for the MSE network at ECB and nonterrestrial communications connectivity to TRI-TAC between ECB and EAC. Range extension augmentation at ECB when deployed without EAC support. This also includes connectivity to/from CONUS/sustaining base. Based on current and anticipated future operations the Corps requires high-capacity augmentation to meet certain operational requirements.

e. Range extension and switch connectivity in support of deployed Army Special Operations Command (SOCOM) units and headquarters both joint and Army. The mission of the Special Operations Signal Battalion is to support deployed Army SOCOM Headquarters and/or Army/Joint special operations contingency deployments. These terminals will provide range extension connectivity between selected Army SOCOM headquarters and operating bases. One or more terminals will provide connectivity back to CONUS/sustaining base via STEP or commercial satellite interfaces for entry into the DISN. Links may also be provided to other services, EAC/ECB switched systems, Joint/allied headquarters, staging bases, and other locations depending on the deployment scenario.

f. Several other units will be provided both switch and standard versions. These units will primarily use these terminals to provide range extension between deployed forces, contingency operations, or as mission needs dictate. The AN/TSC-156(V)3/4/5 will be available for contingency operations as deemed appropriate by the National Command Authorities. As a contingency asset, the AN/TSC-156(V)3/4/5 may be deployed outside of routine operational parameters to provide a high data throughput/switching capability. This mission could be in support of any number of worldwide military operations or civil support measures.

ANNEX H TO APPENDIX A TO ENCLOSURE D

AN/TSC-152 LIGHTWEIGHT MULTIBAND SATELLITE TERMINAL

1. Introduction. This annex contains a brief functional system operational description of the AN/TSC-152 LMST.

2. System Function. The AN/TSC-152 is a multiband satellite terminal, configured in a lightweight, highly mobile trailer and used to provide easily deployable, long-haul communications. The AN/TSC-152 is a nonnodal terminal designed to operate in a point-to-point configuration with one other terminal, or as a spoke terminal in a hub-spoke configuration. Figure D-A-H-1 illustrates the point-to-point and hub-spoke satellite communications configurations.

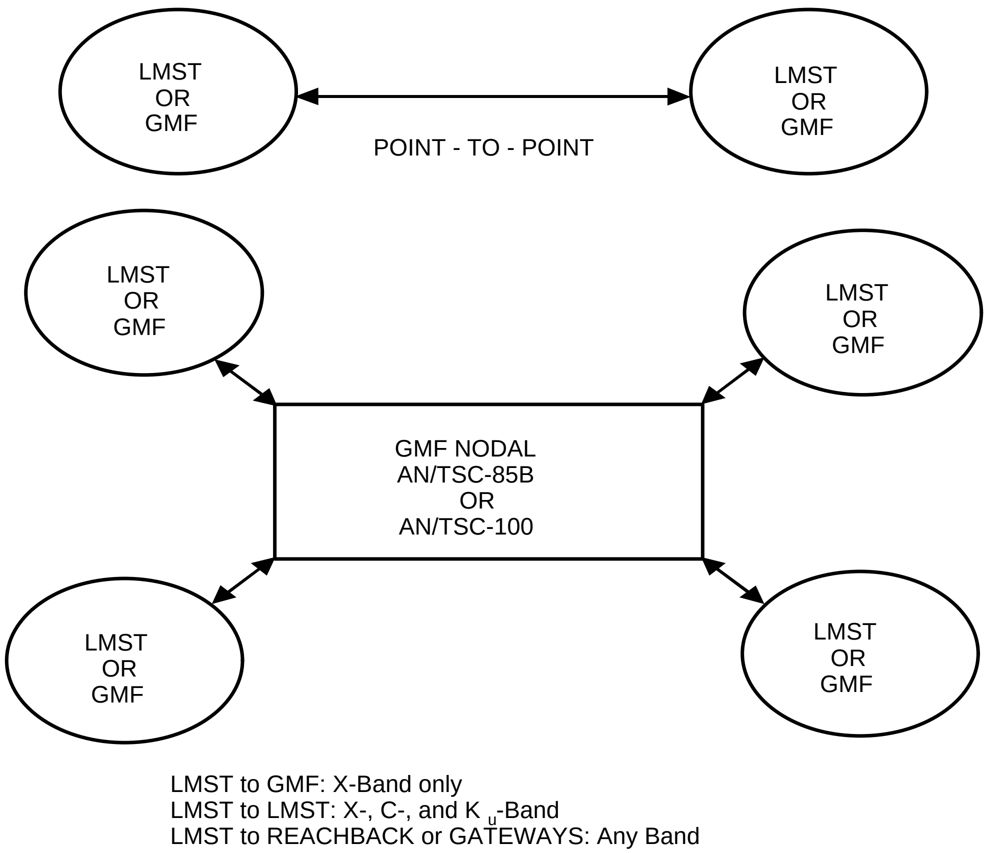


Figure D-A-H-1. Typical LMST System Network Configuration Diagram

a. The AN/TSC-152 operates in the SHF commercial and military bands, (C, X, and K_u). The terminal provides two complete chains, or strings of communication equipment, for support of single antenna or redundant operation. For dual antenna operation, the internal 2.4-meter antenna serves as one antenna and an external antenna is used as the second antenna. Three types of external antennas are supported: AS-3036 (8-ft), AS-3199 (20-ft), and OE-361 (20-ft). For single antenna operation, either the internal 2.4-meter antenna or one of the external antennas can be used. Refer to Figure D-A-H-2.

b. The AN/TSC-152 interoperates (at X-Band) with the GMF AN/TSC-85/-93/-94/-100 terminals and DSCS gateways.

c. The AN/TSC-152 is capable of operating worldwide with any spacecraft of the DSCS II, DSCS III, NATO III, NATO IV, International Telecommunications Satellite Organization (INTELSAT), European Telecommunications Satellite Organization (EUTELSAT), Pan American Satellite Organization (PANAMSAT), and Domestic Satellite (DOMSAT).

(1) <u>System User Interfaces</u>. All user interfaces are through the SEP, located on the curb-side external surface of the trailer. User baseband signals interface via the SEP to the circuit multiplexer (CMX), satellite multiplexer (SMX), G.703, or directly to the modem.

(2) <u>Communications Link Data Rates</u>. The communications modems support link data rates for all three operating bands, ranging from 9.6 Kbps to 8.216 Mbps.

(3) <u>Communication Protection</u>. The terminal includes COMSEC devices (KY-57) for the protection of orderwire communications. Transmission security (TRANSEC) devices (KG-94A) are provided for link encryption.

(4) <u>Transmit/Receive Operation</u>. The AN/TSC-152 is capable of operating the internal tri-band antenna simultaneously with an external X-Band antenna. Therefore, the AN/TSC-152 can simultaneously transmit and receive one full-duplex communication (mission) carrier and one orderwire carrier per antenna.

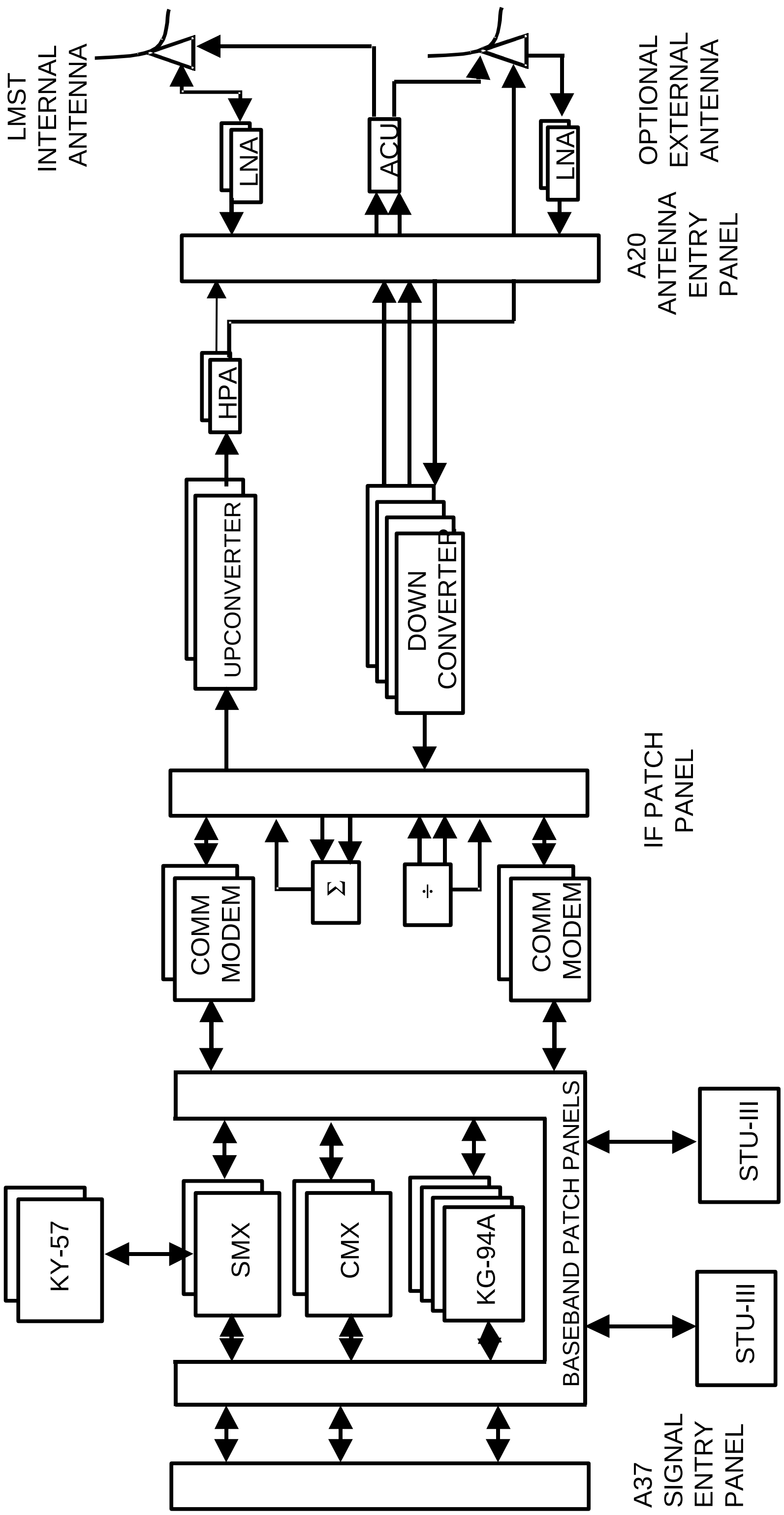


Figure D-A-H-2. AN/TSC-152 Simplified Block Diagram

(5) System Functional Breakdown. The AN/TSC-152 is divided into six functional equipment groups. The groups and the major components within each group are briefly described in the following paragraphs.

3. Baseband Group. The baseband equipment provides conditioning, encryption/decryption, multiplexing/demultiplexing, and modulation/demodulation functions that interface user signals with the transmitter and receiver qroups.

a. Signal Entrance Panel. The SEP provides all analog and digital electrical interface connections to users and subscribers.

b. Baseband Patch Panel. The B/B P/P provides the capability for connecting composite baseband signals (KG-94A black side, external mux line side, or circuit mux line side) to the modem and for connecting the composite side of the satellite mux to the modem. It also provides the means for connecting T1/E1 signals between the SEP and the KG-94A, or directly to the modem. The B/B P/P provides a capability for monitoring the baseband signals. The B/B P/P patch connectors and cabling are arranged such that the normal configuration is straight through, requiring no patching.

c. Circuit Multiplexer/Demultiplexer. The CMX (first-level mux) is an operator-programmable microprocessor-controlled mux/demux. It accepts a combination of digital and analog (voice) signals from up to 12 user channels (8 digital and 4 CVSD). The inputs and outputs are available at the baseband patch panel for patching as needed. The CMX is compatible and interoperable with the TD-1389(P)(V)2/G (LRM) used in the AN/TSC-85/93/94/100 GMF terminals. Two CMXs are provided. When one antenna is used, the CMXs can be operated in tandem, or one can be online with the second one serving as an in-place spare. When using two antennas, one CMX can be used with each link. The CMX consists of five basic functional elements as shown on Figure D-A-H-3.

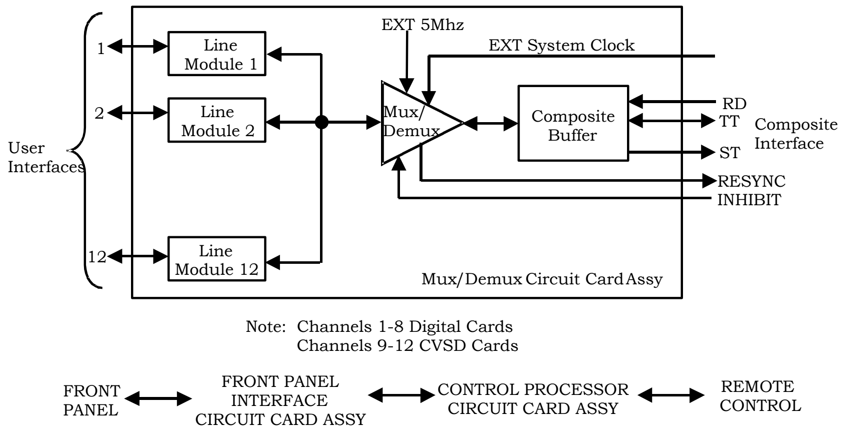


Figure D-A-H-3. CMX Functional Block Diagram

(1) Line Modules. Line modules convert the signals interfacing with external user equipment to the levels and formats required for compatibility with the multiplexer and demultiplexer functions. Plug-in line modules are used to allow rapid reconfiguration. A plug-in card slot is dedicated to each of the 12 channels. The CMX is configured with eight digital (channels 1-8) and four CVSD (channels 9-12) line modules. The type of interface (line type) for each channel is determined by line module installed. Other interface characteristics (e.g., data rate and data timing) are programmed by data entries from the front panel or the control monitor alarm (CMA) interface. Line modules contain separate transmit (multiplex) and receive (demultiplex) sections that can be programmed independently.

(2) Multiplexer/Demultiplexer. The multiplexer combines the channel inputs from the line modules into a single composite data stream that operates up to a maximum data rate of 256 Kbps. The demultiplexer accepts composite data from a distant end multiplexer, separates the data associated with each channel from the composite data, and distributes the channel data to the appropriate line module. Timing can be derived from an external 5-MHz reference signal, the demultiplexer composite clock input, or a multiplexer composite clock input. Programmable resync and inhibit interfaces for interfacing with an external encryption/decryption device are also provided. The multiplexer and demultiplexer operating characteristics are programmed by data entries from the front panel or the remote control interface. The

multiplexer and demultiplexer functions can be programmed independently.

(3) Composite Driver/Receiver. The composite driver/receiver supports balanced NRZ composite signals or balanced CDϕ composite signals in accordance with entries from the front panel or the remote control interface.

(4) Control Processor. The control processor converts front panel or remote control entries into the format necessary to properly program the line module, multiplexer/demultiplexer, and composite driver/receiver functions. The control processor also reports the unit status and the current operating configuration to the front panel and the remote control interface.

(5) Front Panel Interface. The front panel interface converts front panel control entries (keystrokes) into a format compatible with the control processor and converts control processor data outputs into the formats necessary to drive the alphanumeric display and lights on the front panel.

(6) Line Module Compatibility. The line module type and setup combinations shown in Table D-A-H-1 (Group 1-5) are end-to-end compatible. All of the line module and setup combinations shown in any given receive group are compatible with the entire line module and setup combinations in the corresponding transmit group. Data-rate selection requirements are not shown since the receive data-rate selection must match the transmit data rate selection in all cases. FSK line module setup parameters are included to show compatibility if a TD-1389 type multiplexer is used at one end of the link. The data-rate selections available for the TD-1389 FSK line module are shown in Table D-A-H-2.

d. Trunk Encryption Device. The TED is a KG-94A, which provides transmission security. The TED is normally inserted between the CMX and the SMX. The normal CMX to TED to SMX connections can be altered at the B/B P/P. Two KG-94As are provided, with expansion space for the future addition of two more units.

Table D-A-H-1. End-to-End Line Module Compatibility-Groups

TRANSMIT LINE MODULE		RECEIVE LINE MODULE	
TYPE	SETUP	TYPE	SETUP
Group 1			
CVSD	Levels set to suit local user	CVSD	Levels set to suit local user
		Digital	NRZ Interface INT or DEM clock Stuff/delete disabled
		Digital	CDϕ Interface Stuff/delete disabled
Group 2			
Digital	NRZ Interface EXT or REC clock Stuff/delete enabled	Digital	NRZ Interface INT or DEM clock Stuff/delete enabled
Digital	CDϕ Interface Stuff/delete enabled	Digital	CDϕ Interface Stuff/delete enabled
FSK 1/	REC clock Stuff/delete enabled Frequencies set to match local user	FSK 1/	INT clock Stuff/delete enabled Frequencies set to match local user Level set to suit local user

Table D-A-H-1. (Cont'd)

TRANSMIT LINE MODULE		RECEIVE LINE MODULE	
TYPE	SETUP	TYPE	SETUP
Group 3			
Digital	NRZ Interface EXT or REC clock Stuff/delete disabled	Digital	NRZ Interface INT or DEM clock Stuff/delete disabled
Digital	NRZ Interface DEM clock	Digital	CDϕ Interface Stuff/delete disabled
Digital	CDϕ Interface Stuff/delete disabled	CVSD	Level set to suit local user
FSK 1/	REC clock Stuff/delete disabled Frequencies set to match local user	FSK 1/	INT clock Stuff/delete disabled Frequencies set to match local user Level set to suit local user
Group 4			
Digital	NRZ Interface Start/stop timing Data Length set to suit local user	Digital	NRZ Interface Start/stop timing Data Length set to match TX & suit local user Stop Length set to match TX & suit local user
FSK 1/	Start/stop timing Data Length set to match local user Stop Length set to match local user Frequencies set to match local user	FSK 1/	Start/stop timing Data Length set to match transmit end & local user Stop Length set to match transmit end & local user Frequencies set to match local user Level set to suit local user

Table D-A-H-1. (Cont'd)

TRANSMIT LINE MODULE		RECEIVE LINE MODULE	
TYPE	SETUP	TYPE	SETUP
Group 5			
Digital	Transition encoding/decoding	Digital	Transition encoding/decoding
FSK 1/	Transition encoding/decoding	FSK 1/	Transition encoding/decoding

1/TD-1389 Only

Table D-A-H-2. Allowable Data-Rate Selections for FSK Signals

LINE RATE (B/S)	SERIAL DATA (NRZ/CDI)	START/STOP TIMING (NRZ)	TRANSITION ENCODING (NRZ)
0-3	--	--	X
37.5	X	--	--
44.5	--	--	X
45	X	X	X
45.45	X	X	X
50	X	X	X
56.8	X	X	X
61.12	X	X	X
74.2	X	X	X
75	X	X	X
100	X	X	X
110	X	X	X
150	X	X	X
300	X	X	--
600	X	X	--
1,200	X	X	--

e. G.703 Signal Interface Converter. The G.703 signal interface converter (GINTF 1 and 2) provides an interface between user equipment T1/E1 data and the TED.

f. Satellite Multiplexer/Demultiplexer. The SMX (second-level multiplexer) is an operator-programmable, microprocessor-controlled mux/demux that provides one uplink and one downlink supergroup. The SMX is compatible and interoperable with the TD-1337(V)4 (TSSP) used in the AN/TSC-85/93/94/100 GMF terminals. Two SMXs are provided. When one antenna is used, one SMX is online and the second one serves as an in-place spare. When using two antennas, one SMX is used with each link. The SMX consists of the following nine functional elements as shown in Figure D-A-H-4:

(1) Multiplexer. The multiplexer combines the group signal inputs into a single composite output. An optional 16-Kbps secure orderwire signal also can be multiplexed into the composite. The multiplexer must be programmed prior to operation to assign the data rate of each input, or port.

(2) Demultiplexer. The demultiplexer separates the composite input signal generated by the distant end terminal into group signals for distribution to the demultiplexer strapping circuit. An optional 16 Kbps secure orderwire signal also can be demultiplexed from the composite. The demultiplexer must be programmed prior to operation to assign the data rate of each output, or port.

(3) Demultiplexer Strapping Circuits. The demultiplexer strapping circuits determine the connections between the group interfaces and the demultiplexer. The strapping circuit connections are programmed prior to operation.

(4) Group Modem. The group modem converts between unbalanced CDϕ group signals and digital signals compatible with the multiplexer and demultiplexer. The group modem is capable of operation at selected rates from 72 Kbps to 1,152 Kbps, and also supports an orderwire connection between the terminal and the source of the group signal.

(5) NRZ Interface Circuit. Each NRZ interface circuit converts between balanced NRZ signals and digital signals compatible with multiplexer and demultiplexer. Each NRZ interface circuit is capable of operation from 64 to 1,152 Kbps.

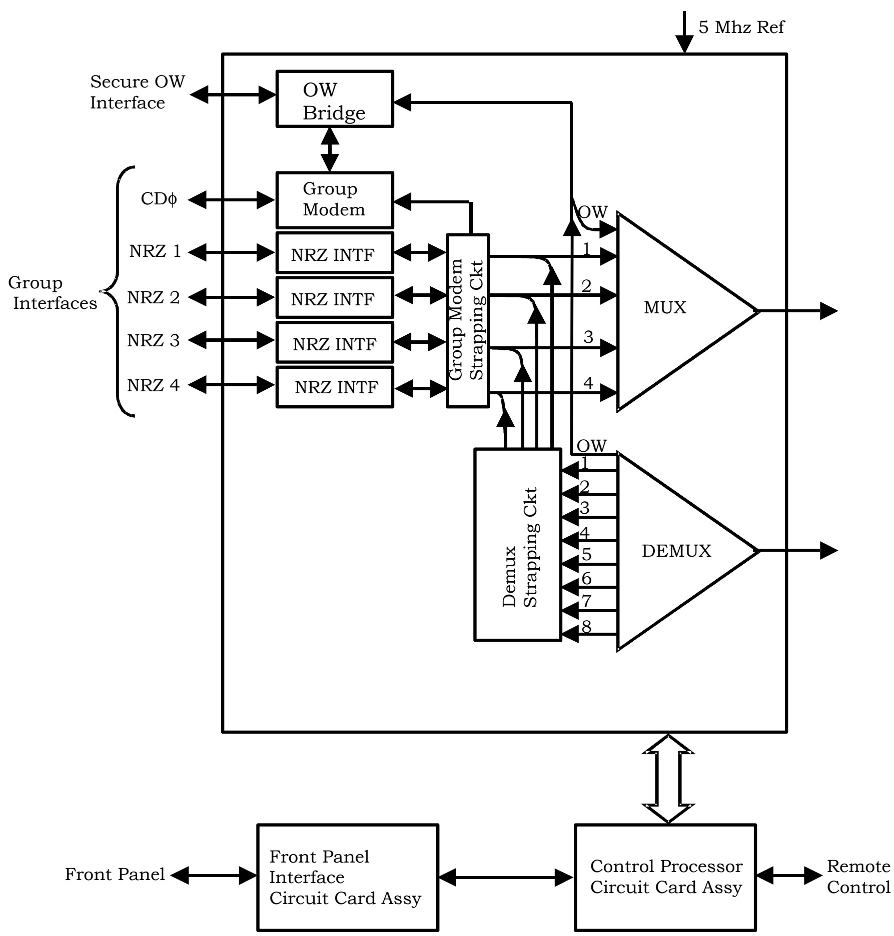


Figure D-A-H-4. SMX Functional Block Diagram

(6) Group Modem Strapping Circuit. The group modem strapping circuit (see Figure D-A-H-5) allows the group modem to be used in place of any one of the NRZ interface circuits if desired to support a particular group signal. The group modem multiplexer strapping must be programmed prior to operation. The group modem port assignment causes the group modem to automatically operate at the same rate as the multiplexer port to which it is strapped.

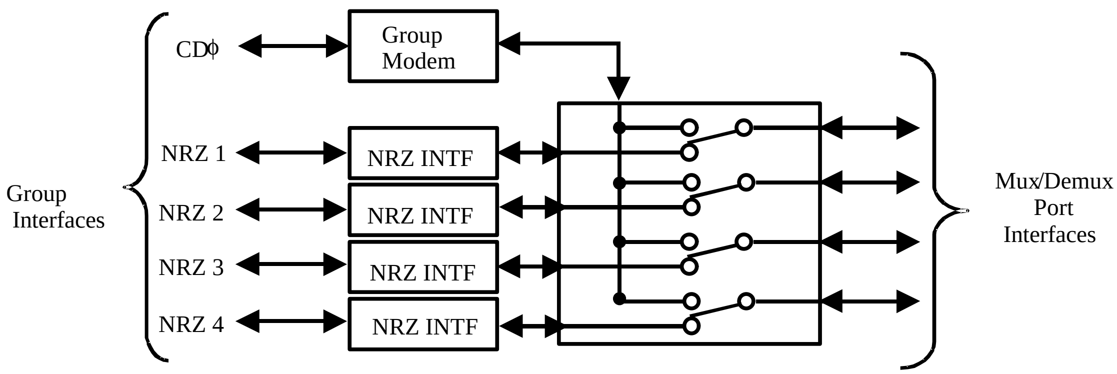


Figure D-A-H-5. Group Modem Strapping Circuit Operation

(7) Orderwire Bridge. The orderwire bridge allows secure orderwire communications over the satellite link and/or over the cable connected to the group modem if the group modem is operating at 256 bps or higher.

(8) Control Processor. The control processor converts front panel or remote control entries into the format necessary to properly program the strapping circuit, multiplexer/demultiplexer, and orderwire functions. The control processor also reports the unit status and the current operating configuration to the front panel and the CMA.

(9) Front Panel Interface. The front panel interface converts front panel control entries (keystrokes) into a format compatible with the control processor and converts control processor data outputs into the formats necessary to drive the alphanumeric display and lights on the front panel.

g. Orderwires. The AN/TSC-152 uses two types of orderwires: control orderwire (COW) and link orderwire (LOW). The equipment required for COW and LOW is described in the following paragraphs:

(1) STU III. Two STU IIIs are provided for use in establishing a voice COW over public switched telephone networks or over a separate in-band carrier via a terminal modem. When the LMST is in the dual antenna mode, the designated orderwire modems are MD 2 and MD 4. If the LMST is in the single antenna mode, the MD 2 is the dedicated orderwire modem.

(2) Interface Converter. Two interface converters are provided to convert the RS-232 output of the STU-III to the RS-422 input required by the orderwire modems.

(3) KY-57 VINSON. The KY-57 VINSON secure voice adapter provides a 16-Kbps digital secure voice LOW capability that is multiplexed into and out of the supergroup by the SMX. An HD-250 handset is provided with each KY-57.

h. Communications Modem. There are four full-duplex digital data communications modems (MD 1 through 4) in the AN/TSC-152. Each of the modems provides baseband formatting, (FEC) coding/decoding, and waveform generation. The modems modulate/demodulate a 70-MHz (± 20 MHz) IF signal with the baseband data. The modem can be set for either BPSK, QPSK, or OQPSK modulation. The modems are compatible and interoperable with DSCS and GMF modems (OM-73, MD-1002, and MD-945). The modems also can operate in an open or closed international business service network via commercial C- or K_u-Band satellites. The designated NCT orderwire modems are MD 2 and MD 4. When LMST is in the dual antenna mode, the designated orderwire modems are MD 2 and MD 4, if LMST is in the single antenna mode, then MD 2 is the dedicated orderwire modem.

i. Attenuator Assembly. The attenuator assembly provides four independent, manually operated step attenuators used to establish the initial (premission) level of each transmit carrier. Each step attenuator covers a range of 0- to 70-dB steps. The attenuators are inline with the modem IF output and the two-way combiner that combines the communication and orderwire carriers. The combined signal is fed to the upconverter. Because the step attenuator interrupts the signal when the attenuation is changed, it is adjusted prior to a mission. During a mission, the level of each transmit carrier is adjusted by IF output level commands to the modem, which allows the carrier to be adjusted over a 25-dB dynamic range without signal interruption.

j. IF Patch Panel (IF P/P). The IF P/P provides patching capability for the IF signals between the modems and the frequency converters. Normal straight through patching is provided by patching plugs. Alternative patching is handled by short patch cables. The IF P/P also allows the user to interface directly to the frequency converters via the SEP.

4. Transmitter Group. The transmitter group consists of two tri-band upconverters (U/CI and U/C2), upconverter redundancy switching (part of the RF patch panel), two high power amplifiers (HPA1 and HPA2). HPA switching assembly, and the HPA controller. The HPAs and upconverters can function as two independent transmit chains for operation with two antennas, or they can function as a single redundant chain for operation with a single antenna, either the internal antenna or the optional external antenna. The 70-MHz IF signals from the baseband group are translated by the upconverters to the C-, X-, or K_u-Band transmit frequencies. The RF output of the upconverters drive the HPAs, which produce the high power levels fed to the antenna(s) via the HPA switching assembly.

a. Upconverter. The tri-band upconverter receives modulated 70-MHz IF carriers from the modem and translates them up to the C-, X-,or K_u transmit bands. The upconverter is tunable in 1 kHz steps. Normally, each upconverter handles two carriers: the communication (or mission) carrier and the orderwire carrier. Both IF input carriers must be within the 50- to 90-MHz range.

b. High-Power Amplifiers. The tri-band HPA receives transmit signals from the upconverter and amplifies them. The HPA uses a tri-band traveling wave tube amplifier (TWTA) capable of producing 400 W (56 dBm) of RF power.

c. HPA Switching Assembly. The HPA switching assembly allows the allocation of HPA1 or HPA2 to either the internal antenna or optional antenna. It also provides dummy load switches for routing the transmit signal into a dummy load or to the antenna for transmission to the satellite.

d. HPA Controller. The HPA controller controls and monitors the HPAs and the HPA switching assembly. It also provides the interface to the CMA for control and monitoring of the HPAs and switches via the operation interface unit (OIU).

5. Receiver Group. The receiver group consists of three single-band, dual LNA assemblies; LNA controller, receive signal power distribution, patching, and switching (part of the RF patch panel); and four downconverters. Downconverters D/C1 and D/C2 are a redundant pair, each allocated to receiving the composite communication and orderwire carriers. Downconverters D/C3 and D/C4 are a second redundant pair, allocated to the antenna control unit for use in tracking the satellite. When operating with two antennas, each unit of the redundant pairs can be allocated to either antenna. The LNA amplifies downlink signals received from the receive port of the antenna. Power dividers and patching within the RF patch panel route the LNA output signals to the four downconverters. The downconverters translate the input RF signals (C-, X-, or K_u-band) down to a 70-MHz IF. The IF outputs of D/C1 and D/C2 are fed to the modem. The IF outputs of D/C3 and D/C4 are fed to the antenna control unit for satellite tracking.

a. Dual Low-Noise Amplifier Assembly. Three single-band dual LNA assemblies are provided for C-, X-, and K_u-Band. Ganged input/output switches determine which unit (LNA1 or LNA2) is online. The input switch is waveguide; the output switch is coaxial. The LNAs are solid-state, uncooled.

b. LNA Controller. The LNA controller provides DC power and redundancy switch control for the internal antenna and external antenna LNAs. It also provides the interface to the CMA for control and monitoring of the internal LNAs and redundancy switches from the laptop computer.

c. Downconverter. The tri-band downconverter receives downlink C-, X-, or K_u-Band RF signals from the LNA and translates them down to 70 MHz IF. The downconverter is tunable in 1-kHz steps. The downconverters that receive the communication and orderwire carriers will normally be tuned such that the communication carrier is translated to 70 MHz, which means the OW carrier will be offset from 70 MHz.

6. Antenna Group. The antenna group consists of an antenna mounted on the trailer feeds to support each of the three bands, and an antenna control unit. The terminal also interfaces to and controls a second optional X-Band antenna.

a. Antenna Assembly. The antenna assembly consists of an elevation-over-azimuth pedestal, 8-ft offset-fed reflector, and a retractable feed boom assembly, which is equipped with interchangeable feed and LNA assemblies for C-, X- and K_u-bands.

(1) Antenna Reflector and Structure. The antenna reflector consists of a honeycomb composite dish and mounted to a backup structure that connects to the azimuth and elevation drive assemblies. The antenna is capable of electrical drive over an azimuth range of ±95 degrees and an elevation range of 5 to 85 degrees.

(2) Feed Boom. The feed boom supports the waveguide, filters, feed, and dual LNA assembly. Transmit waveguide and transmit filters for all three bands are permanently mounted on the feed boom. The band-specific interchangeable assemblies consist of receive waveguide, filters, coupler, feed horn, orthomode transducer (OMT), and polarizer. Only the X-Band LNA assembly is mounted to the feed boom assembly, the C- and K_u-Band LNAs are part of their respective feed assembly.

(3) Stow Position. When the antenna is driven to the show position, the spring-loaded spars help to retract the feed boom beneath the reflector. When the antenna reaches the stowed position, the antenna is secured to the trailer deck by latching the antenna stow support legs. The feed assemblies are removed before the antenna is stowed.

b. Antenna Control Unit . The ACU provides positioning and tracking control of both the internal antenna and the optional external antenna. Antenna tracking is done using a step-track algorithm. The ACU receives terminal position information (latitude and longitude) from the GPS receiver located in the frequency standard. It also receives inputs from a fluxgate compass and a clinometer. These inputs are used as aids in the initial acquisition of the satellite. The ACU controls the antenna(s) through the servo amplifier unit.

c. Servo Amplifier Unit. For the internal antenna, the SAU provides drive signals to the azimuth and elevation drive motors that move the antenna. For the external antenna, the SAU provides drive signals to the elevation and cross-elevation actuators. The SAU also provides antenna safe interlocks to stop antenna motion.

d. Fluxgate Compass. The fluxgate compass provides an indication of the heading of the trailer, referenced to magnetic north. This measurement is used by the ACU to initially point the antenna. The operator, at the ACU, enters the deviation between magnetic north and true north.

e. Clinometer. The clinometer, located at the base of the antenna pedestal, measures trailer tilt (roll and pitch axes). The tilt measurements are used by the ACU to compensate for trailer tilt when computing pointing angles in topocentric coordinates.

f. External Antenna Entry Pane1. The AEP provides an entry point for signals to and from the optional external antenna.

7. Auxiliary Equipment Group. The auxiliary equipment group includes all the nonmission electronic equipment for use in the setup, control, performance monitoring, and maintenance of the system.

a. Control, Monitor, and Alarm Equipment. The CMA equipment provides the capability to configure, monitor, and control terminal operation and performance. The CMA provides the operator a remote interface to the terminal. The primary operator interface to the LMST is through the CMA. The CMA consists of a front end processor and an operator interface unit.

(1) Front End Processor. The FEP consists of a 68040 processor, software, and audible and visible alarm indicators. The FEP, which is permanently located with the terminal, provides the control, monitoring, and alarm interface for the communication equipment. It stores and collects the data from various equipment groups, compares new data with the old data, and updates the OIU.

(2) Operator Interface Unit. The OIU is a ruggedized laptop computer, providing a keyboard, display, and software for remote operation of the terminal. The OIU can be located at the terminal or used remotely, up to 300 feet, via a coax Ethernet cable.

b. RF Patch Panel. The RF P/P provides redundancy switching for frequency converters, signal selection and routing, and an interface point for the RF signals. The RF P/P provides the flexibility of patching alternate signal paths when equipment problems are suspected. Additionally, the RF P/P contains a tri-band test translator, which provides a means of performing system RF loopback testing. A band selection switch on the front panel of the RF P/P allows RF loopback in any of the three operating bands. A manual attenuator (0 to 45 dB range) is provided for adjusting the level of the translated signal. Translator loop tests can be done as offline tests or online tests. For online testing a sample of the HPA output transmit signal is patched to the test translator, where it is translated to the receive band and then patched to the offline receive equipment string. The translated test signal can be patched to the input of either internal antenna LNA, the external antenna LNA, or to the offline downconverter.

c. Frequency Standard. The frequency standard uses GPS signals to provide an accurate 5-MHz reference frequency for local oscillators and clocks throughout the system. The frequency standard reports the terminal geographic position to the ACU to aid in satellite acquisition and pointing.

d. Spectrum Analyzer. A spectrum analyzer is provided for monitoring the IF signals. This equipment is primarily used for troubleshooting. The IF signals can be accessed at the IF P/P or at the front panel of the upconverters and downconverters.

e. Bit Error Rate Test Set. A BERTS is provided for the measurement of system BER performance. Baseband signals are accessed at the B/B P/P.

8. Trailer Group. The trailer group consists of the trailer used to mount and house all the other functional groups, diesel generators and fuel system together with controls, displays, and automatic/manual switchover equipment, interfaces to external power sources,

environmental control equipment, and storage space. Refer to the LMST Trailer Subsystem manual for detailed information.

a. External Power Sources. The AN/TSC-152 is capable of operating from the following external power sources: 120/208 VAC ± 10%, three phase, five wire, 50/60 Hz ± 5%, 10 kW; 120 VAC ± 10%, single phase, three wire, 50/60 Hz ± 5%, 10 kW; and 240 VAC ± 10%, single phase, three wire, 50/60 Hz ± 5%, 10 kW. A transformer is provided for conversion of the 240 VAC input into 120 VAC.

b. Generators. The AN/TSC-152 is equipped with two 10-kW diesel generators. Either generator can be selected as the backup unit in the event external power is lost. If external power is not available, then one generator can be selected as the online unit with the other generator serving as a backup unit. Each generator produces 120 VAC, single phase, 60 Hz. Each generator is powered by a three-cylinder, water-cooled, direct-injection, diesel engine. The engine control unit allows the operator to start the engine manually or place it in automatic standby. The control unit monitors engine oil pressure, temperature and speed, and displays faults.

c. Automatic Transfer Switch. The automatic transfer switch automatically starts the backup diesel generator and puts it online in the event the external power source is lost or the on-line generator fails.

d. Power Control Panel. The PCP provides AC power control and distribution to the terminal equipment.

e. Battery Charger. The battery charger charges the trailer batteries and provides 12 VDC to the automatic transfer switch.

f. Power Entry Panel. The PEP provides an entry point for primary AC power derived from an external power source. The PEP has three independent input connectors, one for each of the three types of external power defined in subparagraph 8a.

g. Environmental Control Equipment. The ECU is a closed recirculating system which provides cooled or heated air to the rack-mounted equipment. The ECU continuously recirculates the air and the heat/cool cycles are automatically controlled by thermostats.

9. Baseband Group Signal Flow. Figure D-A-H-6 shows the block diagram for the baseband group. User signals interface with the terminal at the SEP. The signal labels shown in Figure D-A-H-6 match those marked on the physical SEP. Up to 12 channels of analog voice frequency (VF)/digital signals interface to the terminal at the SEP ports labeled V/Digital 1 and Clock 1. The user VF/digital signals are routed to baseband patch panel 1 (B/B P/P 1). The B/B P/Ps are designed for normal-through operation, which allows normal connectivity to be made without the use of any patch cords. The normal-through connections are shown as dashed lines on the baseband patch panels in Figure D-A-H-6. User VF/digital signals are patched through to the circuit side of the circuit mux (CMX 1), where the individual channel signals are multiplexed to form an aggregate balanced NRZ output signal. In the reverse direction, the received aggregate balanced NRZ signal is demultiplexed into the individual user channel signals. The aggregate, or line side, of CMX 1 is patched through to the red side of TED 1, which performs link encryption to provide transmission security. The black side of TED 1 is patched through to port 1 of the satellite mux (SMX 1). Except for B/B P/P1 and B/B P/P2, all signals appearing at the B/B P/Ps are balanced NRZ.

a. User T1/E1 rate interfaces that need to be link encrypted go through the G.703 interface converter (GINTF 1), which converts the T1/E1 G.703 signals to balanced NRZ format for compatibility with the KG-94A. In this case, the balanced NRZ side of GINTF 1 is patched across to the red side of KG-94A 2. The black side of KG-94A 2 is patched to the modem.

b. Two user digital group signals (Dig GRP 1 and Dig GRP 2) can be connected at the SEP and patched through to group ports 3 and 4 of SMX 1. The four group ports of SMX 1 are balanced NRZ. The SMX also provides one CDϕ interface. This is a direct path, appearing at the SEP.

c. The SMX multiplexes the input group signals (up to 4) into a single aggregate (or composite) signal that is applied to the modem. In the reverse direction, the SMX demultiplexes the received signal from the modem into the output group signals (up to 4).

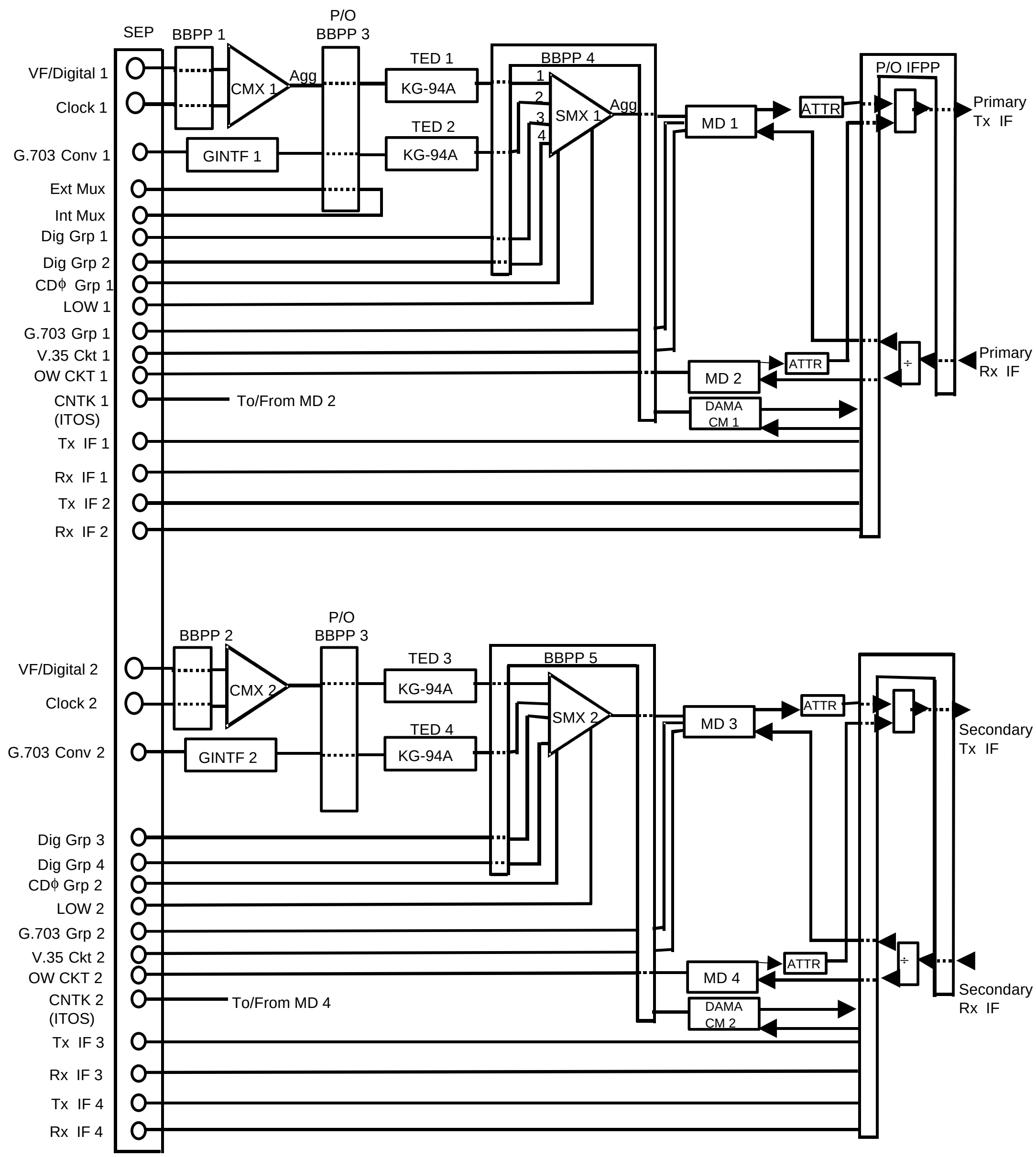


Figure D-A-H-6. LMST Baseband Group Block Diagram

d. The internal CMX can be used in tandem with an external MUX (e.g., AN/FCC-100). In this case, the aggregate side of CMX 1 is patched across to the line to the SEP port labeled INT MUX AGG, which is connected to the circuit side of the external MUX. The aggregate side of the external MUX is connected to the SEP port labeled EXT MUX AGG, which is patched to the red side of TED 1.

e. The aggregate side of SMX 1 is patched through to the baseband port of the modem (MD 1). The modulator side of the modem modulates a 70 ± 20 MHz IF output carrier with the input digital signal. The transmit IF output of MD 1 is routed through a manual step attenuator and two-way power combiner. The power combiner combines the IF outputs of MD 1 and MD 2. The composite IF signal goes to the primary upconverter. Receive IF (70 ± 20 MHz) from the primary downconverter is routed through a two-way power splitter to the receive IF port of MD 1 and MD 2. The demodulator side of MD 1 demodulates the receive IF signal to produce a digital output that is routed to the aggregate side of SMX 1. The IF signals appear on the IF patch panel (IF P/P). The normal through patching on the IF P/P is shown.

f. Modems MD 1 and MD 3 provide three types of baseband interfaces, selectable by the operator: balanced NRZ, G.703, or V.35 circuits connect at the SEP and interface to the modems through B/B P/P 4 and 5, respectably.

g. Four IF interfaces are provided at the SEP and are routed by coaxial cable to the IF patch panel. This gives the user access to the modem side of the IF power combiners and dividers or direct access to the upconverter and downconverter IF ports.

h. The other modems (MD 2 and MD 4) are normally allocated to the net orderwire function. They can be used with the STU III secure telephone or with ITOS. The OW signal interfaces at the SEP port labeled OW Ckt 1, which is routed through B/B P/P 4 to MD 2 and B/B P/P 5 to MD 4.

i. The LOW consists of an HD-250 handset and KY-57 VINSON that connect to the SEP (labeled LOW 1 and LOW 2) and interface directly to the link OW port of SMX 1.

j. The terminal provides expansion space for a second pair of TEDs (designated TED 2 and TED 4) and a pair of demand assigned multiple access control modems (DAMA CM 1 and DAMA CM 2). These expansion units are shown outlined in dashed lines in Figure D-A-H-6.

k. The lower half of Figure D-A-H-6 shows the secondary equipment, which, except for the two interfaces for an external MUX, is identical to the primary equipment. The baseband and IF patch panels also allow secondary string equipment to replace primary string equipment.

l. Both CMX 1 and CMX 2 can be used with one SMX. They can be connected in tandem or in parallel. As an example of tandem operation, the aggregate side of CMX 2 is patched to one of the circuit side-channels of CMX 1 and the aggregate side of CMX 1 is patched through to the RED side of TED 1. The BLACK side of TED 1 is then patched to port 1 of SMX 1. As an example of parallel operation, the aggregate side of CMX 1 is routed through TED 1 to port 1 of SMX 1, and the aggregate side of CMX 2 is routed through TED 3 to port 2 of SMX 1.

10. Transmitter Group Signal Flow. Figure D-A-H-7 shows the block diagram for the transmitter group. The primary and secondary transmit 70 ± 20 MHz IF signals from the baseband group go to a redundancy switch (S1) located in the RF P/P assembly. The upconverter input switch is electrically ganged with the output switch (S2). The position of the two switches determine which upconverter is the primary (online) unit. The switches are shown in position 1, which makes U/C 1 the primary unit. The upconverters translate the 70 ± 20 MHz IF signals from the modems up to C-, X-, or K_u-Band. The RF outputs of the upconverters go to the HPA input switch (S1), which is mechanically ganged with the HPA output switch (S2). The position of HPA switches S1 and S2 determine which HPA is the primary unit. The primary transmit RF signal is then routed to the dummy load switch (S3), which switches the transmit signal to either a dummy load or to the internal antenna. A similar switch (S4) follows the secondary transmit output of S2. For normal operation with the internal antenna only, S2 is switched to the dummy load.

a. Each HPA contains a directional coupler that provides a sample of the RF output signal. The sample, approximately 50 dB below the RF output signal, is routed to the RF P/P where it can be patched to the test translator for RF loopback testing.

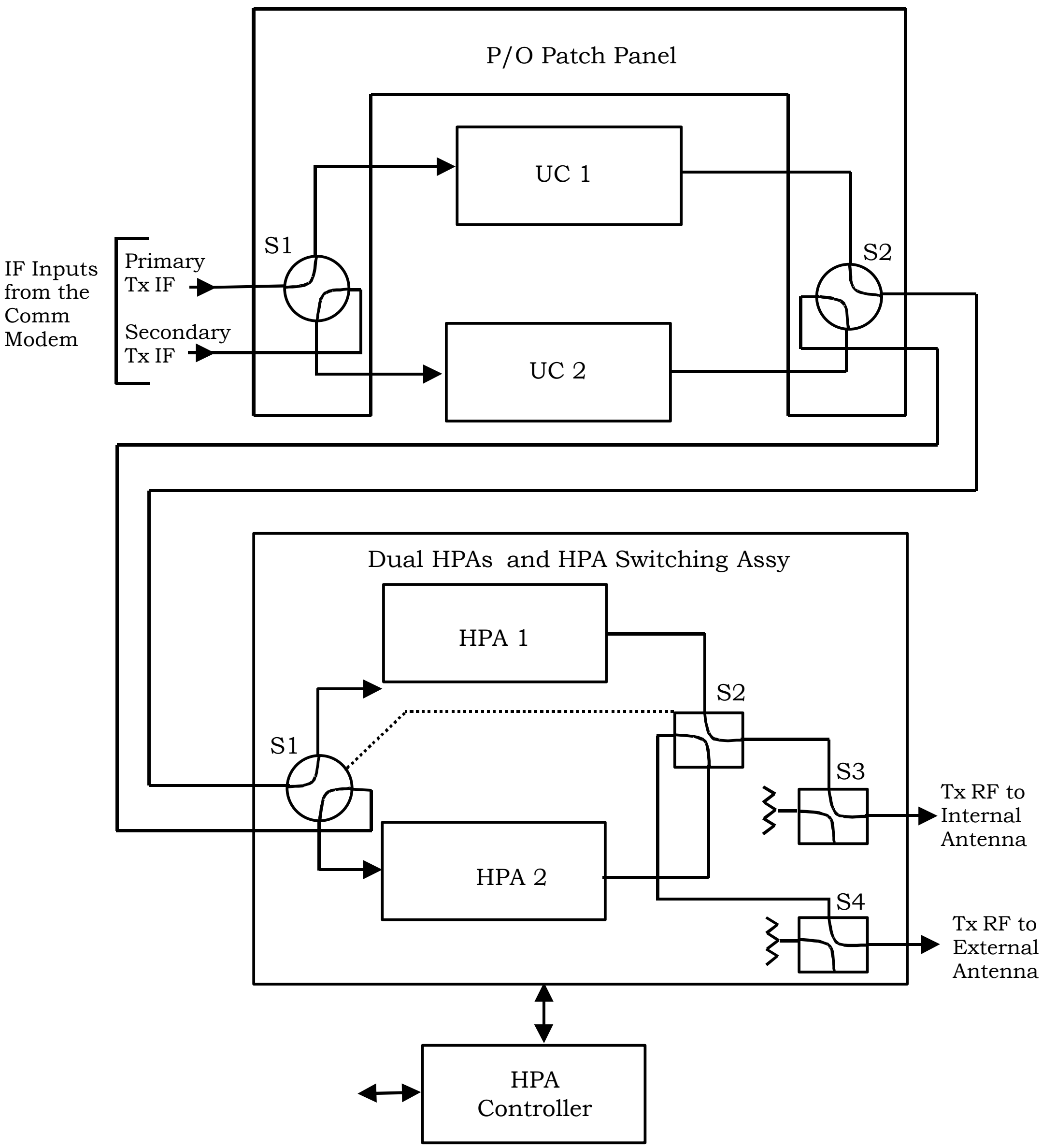


Figure D-A-H-7. LMST Transmitter Group Block Diagram

b. The secondary U/C and HPA can also be used as a second equipment string connected to the external antenna. In this case, the primary string becomes the internal antenna string and the secondary string becomes the external antenna string. The U/C and HPA switches allow either U/C or either HPA to be allocated to either antenna.

c. The upconverter and HPA switches provide the capability for automatic switchover to the backup unit in the event of a detected failure of the primary unit. The upconverter switches can be controlled by the CMA or locally at the RF P/P front panel. Automatic switchover if implemented by the CMA.

d. The HPA and its associated switches are controlled via the HPA controller. Control can be through the CMA or locally at the HPA controller front panel. Automatic switchover for the HPAs is implemented in the HPA controller, not by the CMA.

11. Receiver Group Signal Flow. Figure D-A-H-8 shows the receiver group block diagram. The receive RF signal from the antenna goes to the LNA input switch (S1), which together with the output switch (S2), determines which LNA (LNA 1 or LNA 2) is the primary (online) unit. The switches S1 and S2 are mechanically ganged. There are three LNA/switch assemblies, one per band.

a. The LNA output signals go to the RF P/P for distribution to the downconverters. The online LNA signal is routed to the primary downconverters (D/C 1 and D/C 3) via two two-way power dividers (PD 1 and PD 3). Downconverters D/C 1 and D/C 2 are used for the downconversion of the communication carriers (mission and OW). The downconverters translate the RF input (C-, X-, or K_u-Band) down to an IF of 70 ± 20 MHz.

b. Downconverters D/C 3 and D/C 4 are used for antenna tracking. Normally they are tuned to receive the satellite beacon signal. If the beacon signal is not available or its level is too low for tracking, the tracking downconverters can be tuned to any downlink carrier that provides an adequate signal level for tracking.

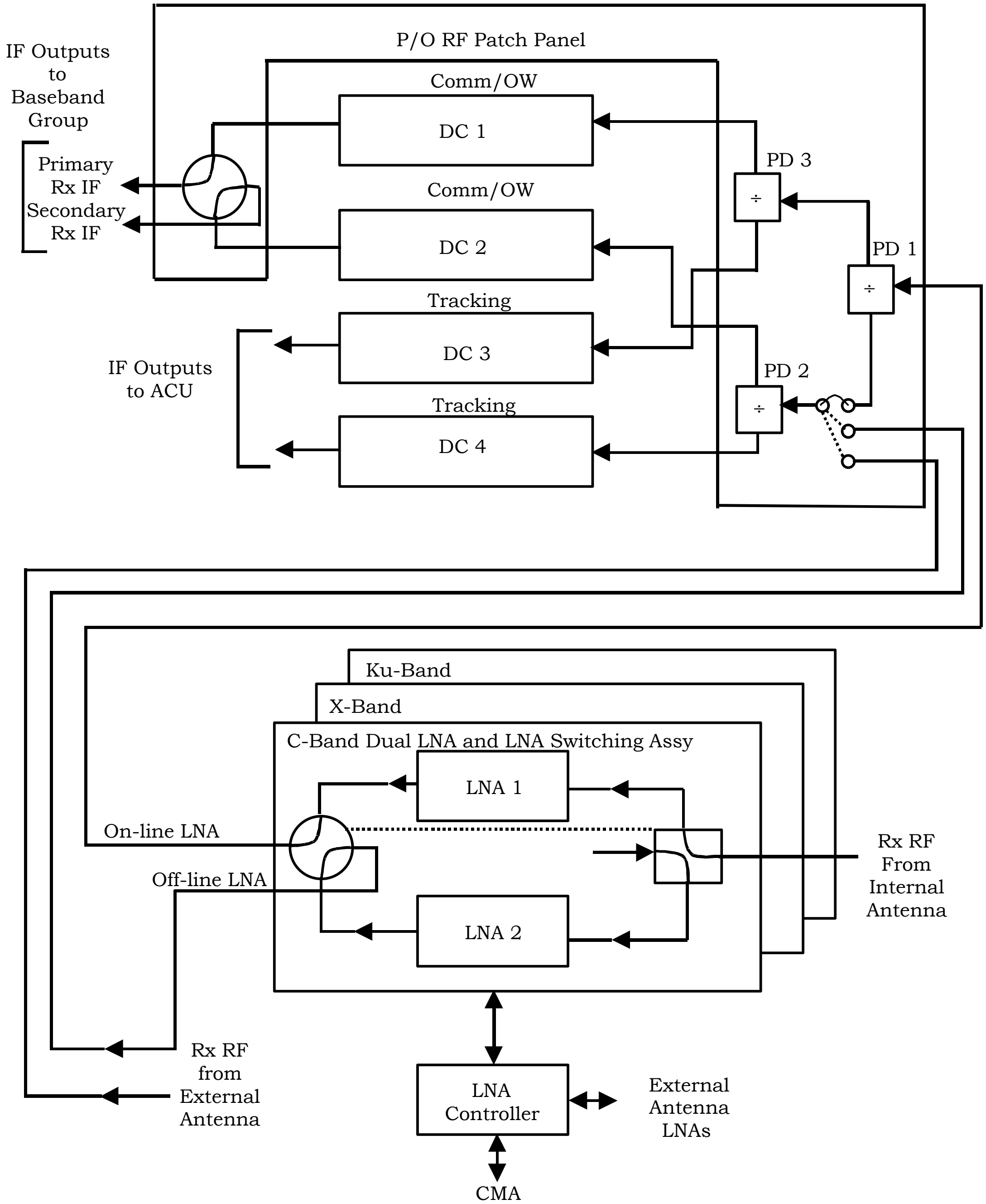


Figure D-A-H-8. LMST Receive Group Block Diagram

c. When operating with the internal antenna only, the secondary output of Power Divider PD 1 is patched to PD 2, which feeds the receive RF signal to the secondary downconverters (D/C 2 and D/C 4). The position of switch S3 in the RF P/P determines which downconverter (D/C 1 or D/C 2) is the primary communication unit. Switches within the ACU select D/C 2 or D/C 4 as the primary tracking unit.

d. For operation with both the internal antenna and an optional external antenna, the receive RF from the LNA in the external antenna is patched to PD 1. In this case, D/C 1 and D/C 3 are allocated to the internal antenna and D/C 2 and D/C 4 are allocated to the external antenna. Switch S3 must stay in position 1 (as shown) for dual antenna operation.

e. Downconverter redundancy switching is normally not available when the terminal is configured for operation with the external antenna only. However, redundancy switching can be achieved by relocating the external LNA cable from its normal connector on the rear panel of the RF P/P to the connector normally used for the internal online LNA signal.

12. <u>Antenna Group Signal Flow</u>. The transmit path For C- and K_u-Band includes an isolator, harmonic reject filter, and transmit filter. The receive path includes a receive filter and directional coupler. The isolator suppresses reflections from the transmit line filters and feed. The harmonic reject filter suppresses harmonics produced by the HPA. The primary function of the transmit filter is to preserve system G/T by suppressing HPA output noise falling in the receive band. The primary purpose of the receive filter is to prevent transmit signals from driving the LNA into gain compression. The orthomode transducer and polarizer are used to isolate the transmit and receive paths and to provide circular or linear polarization as appropriate for each band. The feed horn illuminates the reflector.

a. For X-Band, two additional components are added. A high-band stop filter is used in the transmit line to suppress HPA noise and intermodulation products above the transmit band. In the receive line a bandpass filter is added to suppress interference from the HPA that falls outside the receive band.

b. Figure D-A-H-9 shows the signal flow related to antenna control. The ACU controls the two antennas via the SAU. Servo amp control and current commands are sent to the SAU, which converts them into motor drive power. Position data and tach feedback from the antenna passes through the SAU to the ACU. Status information from the two antennas and from the SAU is passed to the ACU.

c. The ACU provides +12 VDC power to the fluxgate compass and clinometer. The fluxgate compass reports trailer heading (relative to magnetic north) via a serial interface to the ACU. Trailer tilt is reported by analog signals from the clinometer to the ACU. Terminal position (latitude and longitude) is reported by the GPS receiver (located in the frequency standard) via a serial interface.

d. Receive 70-MHz IF from the two tracking downconverters (D/C 3 and D/C 4) go to tracking receivers located in the ACU. The tracking receivers produce estimates of signal strength that are used by the step-track algorithm to track the satellite. For internal antenna only operation, the two IF inputs are redundant. The operator, at the ACU, specifies which IF signal is primary and which is secondary. In the event of a primary downconverter failure, the ACU uses the summary fault alarm from the faulted downconverter to automatically switch to the secondary downconverter.

e. The ACU reports antenna group status to the CMA via five discrete signals (internal antenna fault, external antenna fault, internal antenna autotrack state, external antenna autotrack state, and ACU fault).

13. Antenna Group Acquisition and Tracking Subsystem. The LMST system employs steptracking to autotrack a geosynchronous satellite. Steptrack is an algorithm where the antenna is pointed at predetermined positions around the expected satellite position while the satellite signal strength is measured. The antenna is positioned to maintain the maximum signal strength.

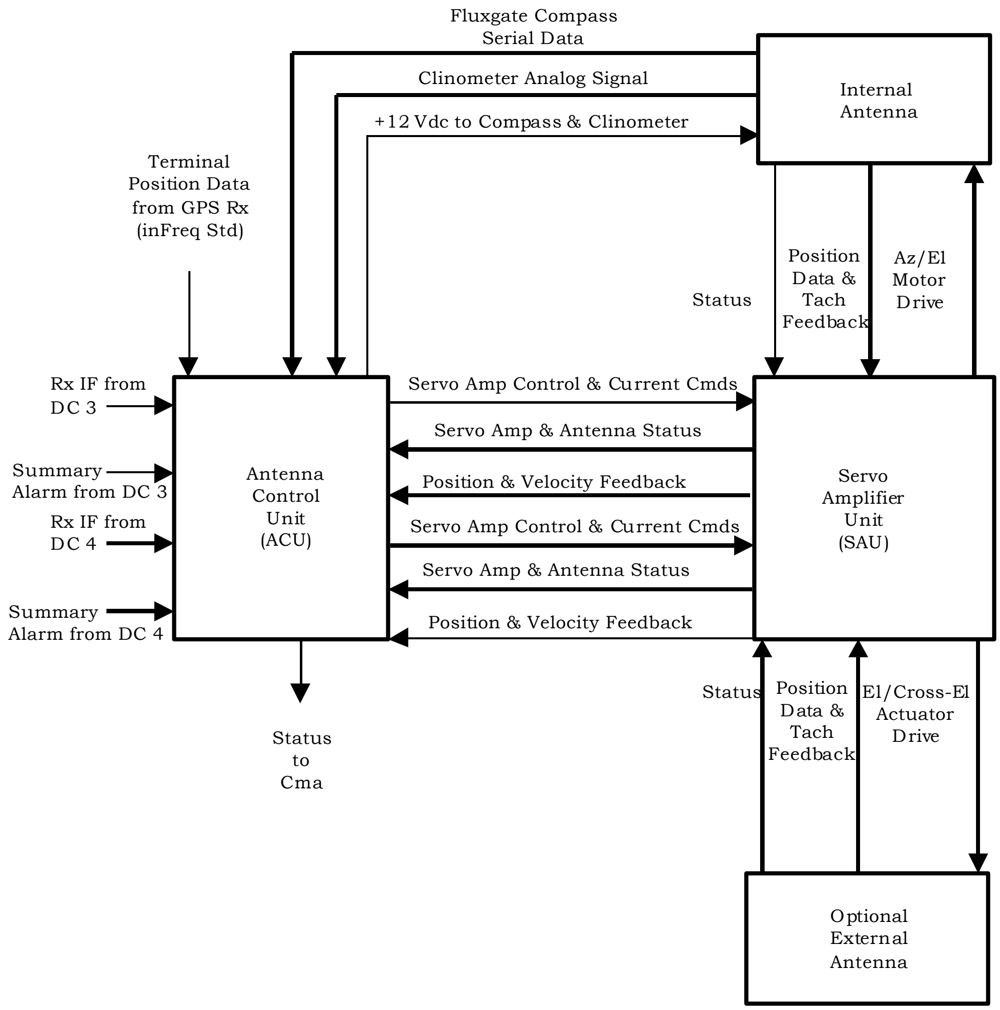


Figure D-A-H-9. LMST Antenna Control Unit Block Diagram

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APPENDIX B TO ENCLOSURE D

MILSTAR SYSTEM DESCRIPTION

1. Introduction. This appendix provides an introduction to the Milstar system and a brief description of the Milstar terminals in use by the Services.

2. General. The Milstar system will provide survivable, endurable, communications for the command and control of strategic and tactical forces through all levels of conflict. Milstar consists of three primary segments: space, terminal, and mission control. The space segment will consist of a constellation of four satellites in geosynchronous, low-inclined orbits. Each satellite will contain an extremely high frequency (EHF) earth-coverage antenna, steerable spot-beam antennas, and agile-beam antennas as well as UHF AFSATCOM and FLTSATCOM transponders. Each Milstar satellite will perform onboard signal processing, employ a common signal waveform to provide tri-Service interoperability, and act as data, voice, and message communications traffic switchboards. The terminal segment will consist of the communications terminals on aircraft, ships, submarines, ground-mobile platforms, and ground-fixed platforms. User terminals will provide communications capability and associated communications control functions. The terminal segment will include Army, Navy, and Air Force EHF/UHF terminals. The Milstar mission control segment will provide survivable and endurable tracking, telemetry, and commanding (TT&C) of the space segment. The mission control segment (MCS) will maintain the satellite constellation in a state of readiness to support user communications requirements during wartime and contingency operations. The MCS will also provide a communications management function including over-the-air TRANSEC and COMSEC rekey to ensure efficient utilization of Milstar communications resources.

a. Operational Characteristics. When fully operational, Milstar will provide worldwide, secure, jam-resistant, low probability of interception (LPI), low probability of detection (LPD), strategic and tactical communications capability to the NCA, Chairman of the Joint Chiefs of Staff, combatant commands, and selected DOD and non-DOD Government agencies. The Milstar frequency bands, waveforms, and signal processing algorithms have been chosen for robustness. The space and MCS are designed with survivability and endurance as major considerations. The resulting Milstar system ensures users can maintain critical communications connectivity through specified levels of conflict using a number of different types of terminals supporting many different strategic and tactical missions. Milstar flexibility allows communications services to be user configurable. Milstar user terminals autonomously request communications payload resources apportioned to them by the Joint Staff. Although the advantage of this flexibility should be self-evident, each Milstar payload has a finite amount of communications resources available that precludes the unconstrained exercise of this flexibility.

b. Technical Characteristics. Milstar employs many features that distinguish it from other MILSATCOM systems such as an onboard processing capability and two cross link antennas per satellite that permit direct LOS communications connectivity with two neighboring Milstar satellites. This onboard processing and cross link (X/L) capability provides global communications coverage without reliance on ground-based relay nodes. Each satellite features a complement of uplink (U/L) and downlink (D/L) antenna types designed to meet the mission requirements of the Milstar user community and "close" the communications link between the satellite payload and ground terminals which exhibit varying performance characteristics.

c. Satellite Constellation

(1) The Milstar satellite constellation can, simultaneously, support many independently configured communications circuits or services. Generically, there are two different types of services characterized by the method of initiation and duration. User-configured services comprise the majority of Milstar networks and are characterized by user initiated C2/C3 protocols. C2 (uplink network control) and C3 (downlink network control) protocols are embedded in the communications channel framing structure between terminal and satellite. User terminals can configure satellite resources flexibly to provide either communications capacity or counterjamming, nuclear effects, degraded terminal environments, and weather. Point-to-point (PTP) calls and Networks/CINCNETS are user terminal configured services. The second type of service is reportback services. Reportback services are characterized as configured by priority to provide specialized service to specific communities. In general, they are permanently installed within the Milstar system. The Milstar satellite LDR payload supports communications services uplink at EHF with data rates of 75 to 2,400 bps and UHF uplink (Milstar DAMA) with data rates of 75 bps. Downlinks operate in the SHF band with data rates at 75 to

2,400 bps or UHF (Milstar DAMA) with data rates at 75 bps or UHF (Fleet Broadcast) with data rates at 1,200 bps. Given compatible data rates, Milstar supports crossbanding (EHF uplink/UHF downlink and UHF uplink/SHF downlink).

(2) The third and subsequent Milstar satellites will be equipped with both medium data rate (MDR) and LDR communications payloads and their associated antenna suites. The MDR payload significantly increases the available communications capacity and provides tactical users with worldwide, secure, jam-resistant, LPI, LPD circuits capable of carrying data at rates up to T1 (1.544 Mbps). The Milstar satellite LDR and MDR payloads both operate in the EHF and SHF frequency bands.

3. Space Segment

a. The space segment is comprised of the earth-orbiting Milstar satellites. Figure D-B-1 is a Milstar satellite system block diagram. The main Milstar space segment resources a user employs to establish a communications service are uplink demodulator accesses (referred to as "uplink slots" or simply demodulates), crosslink time slots (referred to as "slots") if the service requires more than one satellite, and downlink data packets (referred to simply as "hops"). The Milstar space segment employs frequency hopping at low and high hop rates, time and frequency division multiplexing, frequency and phase shift modulation techniques, onboard signal processing, and onboard resource control. Communications signal uplinks received by the Milstar satellites are broken down to the essential digital elements, processed, routed, reassembled, and then transmitted to the appropriate terminals. In technical terms, a Milstar LDR satellite detects the incoming signals on the uplink, frequency dehops, demodulates, recovers and processes data, routes data and messages, time-division multiplexes, modulates, hops, amplifies, and retransmits messages (voice or data). The onboard resource controller and the onboard message processor and data router are two of the unique subsystems on the Milstar satellites that contribute to the flexibility and robustness of the system.

(1) The onboard resource controller is essentially a computer system aboard the satellites that controls the communications. The payload resources controller stores CINC-validated and Joint Staff-approved payload tables that are uploaded from the mission control segment. The controller also processes a user terminal s initial service

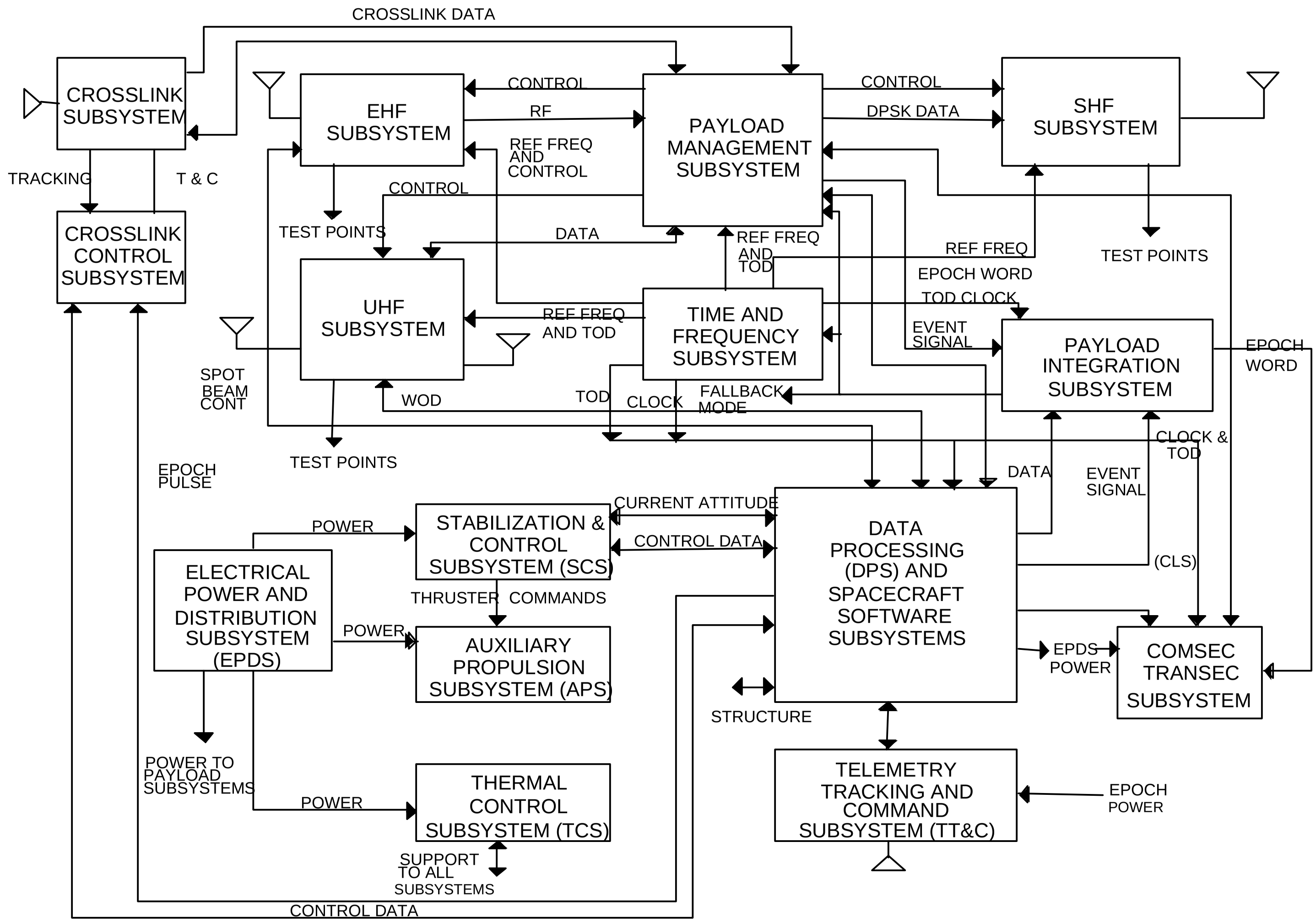

Figure D-B-1. Milstar Satellite System Block Diagram request (ISR) through the C2/C3 access control channels; assigns communications resources; identifies uplink beams, channels, router configuration, crosslink slots, downlink slots, and beams; and terminates the communications services per terminal requests or preemption procedures.

(2) The onboard message processor and data router establish the communications paths for the users. Working with the resource controller, the payload's message processor and data router map uplink channels with downlink channels and satellite-to-satellite crosslinks and assign communications packets to the time-division multiplexed downlink slots.

4. Terminal Segment. Milstar uses several interoperable terminals that are designed for operation as manpacks or configured for installation as ground transportable, fixed ground, airborne, ship borne, and submarine-mounted applications. Milstar terminals are configured for operations based on database inputs. In normal operations, the terminals would be preloaded with configuration data about the satellite orbits, communications services, and other parameters that will allow the terminals to quickly acquire the Milstar satellites and establish the desired communications. (Note: Not all Milstar terminals have communications services preloaded. Army and Air Force terminals do, but Navy NESP communications services must be typed in at the operator's screen.) In addition to the normal Milstar EHF uplinks and SHF downlinks, Milstar also supports UHF AFSATCOM and FLTBCST services with UHF terminal networks. Figure D-B-2 is a block diagram representation of joint Service Milstar terminals. Tables D-B-1 through D-B-3 provide a summary of characteristics for Air Force, Navy, and Army Milstar terminals respectively. (See also Annexes A and B to Appendix B to Enclosure D.)

5. Mission Control Segment. The MCS uses four major software/hardware elements. The mission control element (MCE), which includes the satellite mission control subsystem (SMCS), is the survivable ground control component that will manage the Milstar constellation (orbit and over-the-air rekey) via EHF/SHF telemetry. Constellation control stations (CCS) are the survivable distributed control elements of the MCS and will also provide Class I anomaly monitoring (onboard satellite anomaly detection and resolution) and Class II anomaly resolution (capabilities with the support of the CCS software). The MCE, located in the Falcon AFB Satellite Operations Center

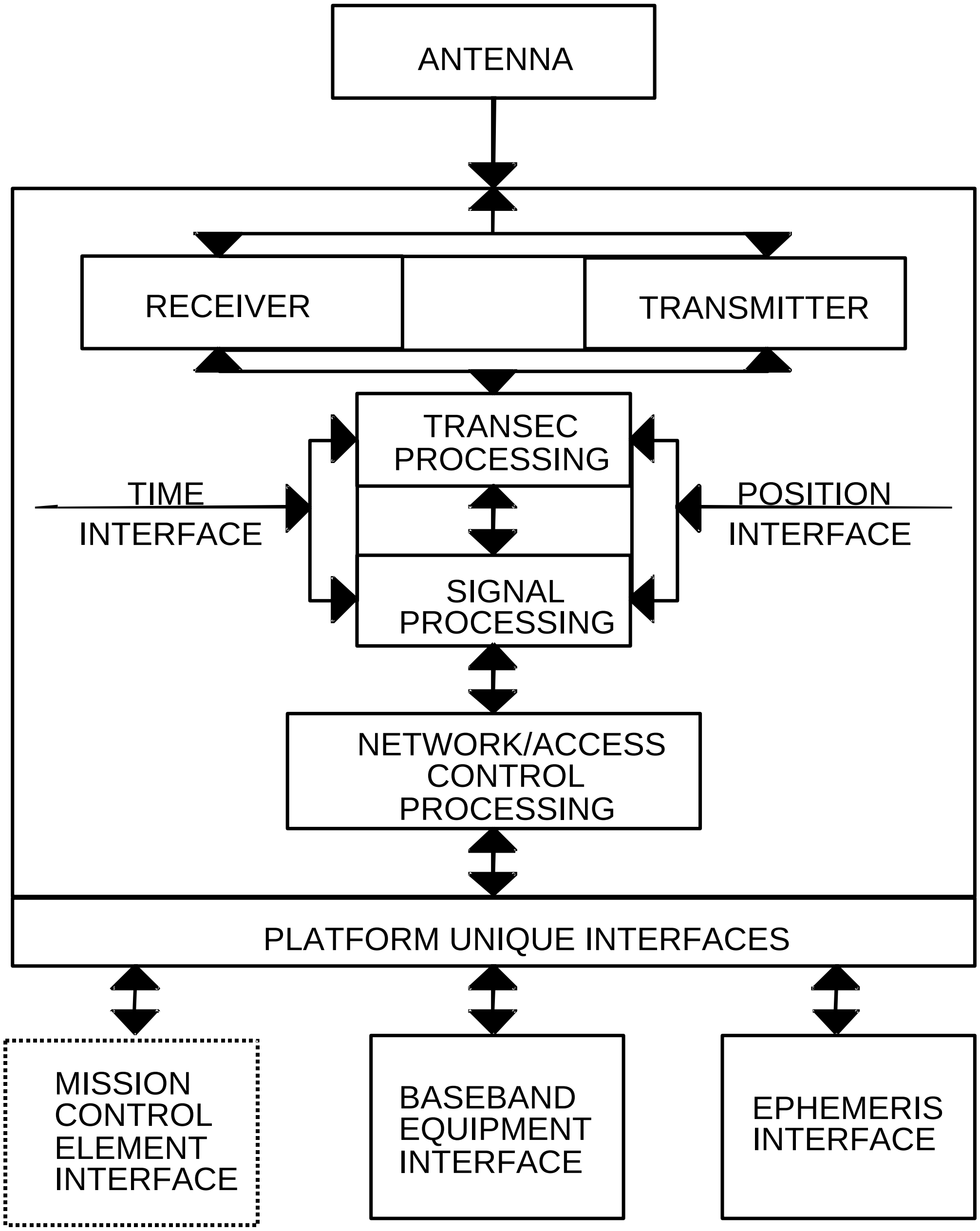

Figure D-B-2. Milstar Terminal Function Block Diagram

Table D-B-1. Air Force Milstar Terminal Characteristics Summary

Characteristic	Terminal					
	EHF/UHF ABNCP ARC-208(V)1,2	EHF ABNCP ARC-208(V)4	EHF/UHF GNDCP FRC-181(V)1	EHF GNDCP FRC-181(V)2	EHF/UHF TRGNDCP TRC-194(V)1 TRC-194(V)4	EHF TRGNDCP TRC-194(V)2
Antenna						
Diameter (in)	26	26	90	90	96	96
Weight (lbs)	165	195	1,000	1,000	1,537	1,537
Remoting Distance (ft)	180	TBD	180	180	50 1/	50 1/
Ports						
TX/ RX (LDR)	10	30	30 2/	30	30 2/	30 2/
RX Only	3	3	3 3/	3	3 3/	3 3/
Distance I/Os can be remoted (ft)	200	200	200	200	200	200
Supported Protocols						
IBC	Y	Y	Y	Y	Y	Y
Reportback Reception	S,B	S,B	S,B	S,B	S,B	S, B
Beam Management	BM, M	BM, M	BM, M	BM, M	BM,M	BM, M
ITW & A	Y	Y	Y	Y	Y	Y
OTAR	Y	Y	Y	Y	Y	Y

1 / If HPA is not collocated with antenna.

2 / Only 8 ports may be simultaneously used for EHF LDR transmitting. Remaining ports for UHFT Tx /Rx. Two of 30 ports are operator control ports which interface to 1553 buses.

3 / Refers to the number of high speed parellel ports. Any of the remaining 28 serial ports can be designated RX only.

NOTES:
B: Bomber
S: Submarine
BM: Beam manager
M: Net member portion.
N: Protocol is not supported.
Y: Protocol is supported.

Table D-B-2. Navy Milstar Terminal Characteristics Summary

Characteristic	Terminal		
	Sub Terminal AN/USC-38(V)1	Ship-Terminal AN/USC-38(V)2	Shore Terminal AN/USC-38(V)3
Antenna			
Diameter (in)	5.5	34.5	72
Weight (lbs)	60	390	1,100
Remoting Distance	50 1/	100 2/	80 /2
Ports			
TX/ RX (LDR)	4	8	8
RX Only	2	4	4
Distance I/Os Can be remoted 5/	1,000	1,000	1,000
Supported Protocols			
IBC	Y 3/	Y 3/	Y 3/
Reportback	N	S	S
Reception	N 4/	N 4/	N 4/
Beam Management	N	N	N
ITW &A	Y 5/	Y 5/	Y 5/
OTAR			

1/ Maximum to periscope input, given a typical number of waveguide bends.
2/ Maximum, given a typical number of waveguide bends.
3/ Navy terminals are compatible with IBC protocol. Will be implemented if funds available.
4/ Protocol will be implemented when funds are available .
5/ Specified value. Remoting capabilities have been demonstrated for distances of 10 miles with commercial equipment.

NOTE: S: Submarine Report back

Table D-B-3. Army Milstar Terminal Characteristics Summary

Characteristic	Terminal			
	SCOTT Terminal AN/TSC -124	SMART-T AN/ TSC-XXX(V)X	SCAMP (V) MP AN/PSC-XXX(V)X	SCAMP 1/ AN/PSC - XXX(V)X
Antenna				
Diameter (in)	66	54	2/	2/
Weight (lbs)	30	3/	3	2/
Remoting Distance (ft)	200 4/	3/	3/	2/
Ports				
TX/RX (LDR)	8	4	1	2/
RX Only	0	0	0	2/
DistI/Os can be remoted (ft) 4/	2,500	2,500	100	2/
Supported Protocols				
IBC	Y	Y	Y	2/
Reportback Reception	N	N	N	2/
Beam Management	M	M	M	2/
ITW&A	N	N	N	2/
OTAR	Y	Y	Y	2/

1/ Terminals in early development (technology development).

2/ No specified value.

3/ Antenna integral to terminal/platform.

4/ Specified value remoting capabilities have been demonstrated for distances of 10 miles with commercial equipment.

supports launch and deployment, early orbit testing, anomaly resolution, and space-ground link subsystem (SGLS) satellite control operations. This element uses mission-unique software to support the initialization of the satellites and provides the S-Band command path when EHF/SHF command and telemetry are not available. The Mission Deployment Element, located in the Falcon AFB Operations Support Facility, provides the environment and software tools for developing and maintaining operational software and databases for the Milstar system including those subsections of payload parameters required by the terminals for satellite access. The MDE will also provide system simulation capabilities. The MPE, located in the Falcon AFB Mission Operations Center (MOC), provides the communications management and performance analysis capability for system level communications planners. An adjunct to the MPE is the operational planning element (OPE), which provides CINCs and users with the local capability to manage their apportioned Milstar resources and autonomously configure user terminals to support communications services.

ANNEX A TO APPENDIX B TO ENCLOSURE D

AIR FORCE MILSTAR TERMINALS

1. Description

a. Configurations. There are four functionally oriented configurations for the AF Milstar Terminal: airborne command post (ABNCP), ground command post (GNDCP), ground force element (GNDFE) terminal, and the transportable ground command post (TR GNDCP). The ABNCP, GNDCP, and TR GNDCP terminals have EHF only and EHF/UHF versions. The TR GNDCP terminal (which is also referred to as the contingency terminal) is housed in an S-280 shelter. Currently, AF Milstar terminals operate only at the Milstar LDR. Each terminal configuration consists of interconnected units selected from a complement of line replacement units (LRU). LRUs are divided into six categories: antennas, core units, EHF amplifiers, interface units, UHF units, and GFE UHF units.

b. Equipment. AF Milstar terminals support secure voice, teletype, data, and facsimile at rates from 75 to 2,400 bps. The AF Milstar terminal crypto devices are KG-84A, KGC-11A, and KYV-5. Table D-B-A-1 lists I/O devices that each port will support.

Table D-B-A-1. AF Milstar Terminals I/O Devices

Ports	I/O Devices
16 RED serial TX/RX (75-2,400 bps)	AGC-7, UGC-120B, UGC-129, ITW&A (TX)
1 RED serial 75-244 bps TX 19.2 Kbps RX	AGC-7, UGC-120B, UGC-129, ITW&A TX/RX 75-2,400 bps or RX 19.2 Kbps
3 RED parallel RX (75-9,600 bps)	High speed printer, SMR/ADP
1 RED 1553 BUS	NONE
12 BLACK serial TX/RX (75-2,400 bps)	UGC-120B, UGC-129, ANDVT/KYV-5, SMCS DATA, IEMATS, AEELS, AIRCOMTERM, KG-84A

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ANNEX B TO APPENDIX B TO ENCLOSURE D

NAVY MILSTAR EHF TERMINALS

1. <u>AN/USC-38(V) Satellite Communication Terminal</u>. The AN/USC-38(V) is a Navy EHF Milstar terminal employed on ship, shore, and submarine platforms. (See also Table D-B-2.)

2. <u>Equipment Configuration</u>. The AN/USC-38(V) is arranged into three equipment groups: communications equipment group (CEG), HPA, and an antenna group. See Table D-B-B-1.

Table D-B-B-1. AN/USC-38(V) Equipment Complement by Platform

Equipment	Platform		
	Ship	Shore	Submarine
Communications Equipment Group	X	X	X
Power Distribution Group	X	X	X
Terminal Control Unit	X	X	X
Terminal Control Processor/Modem	X	X	X
Microwave Processor/Antenna Position Control Unit	X	X	X
Heat Exchanger	X	X	
HPA	X	X	X
Antenna Group	X	X	X
Remote Terminal Control Unit	X	X	
Waveguide Switch	X		

a. <u>CEG</u>. The CEG converts multiple-user signal inputs at baseband to 6.4 to 7.4 GHz hopping RF for application to the HPA. It also provides down-conversion to baseband of the dehopped K-Band signal from the antenna. An LNA and downconverter are located within the antenna for amplification and downconversion of the received signal. The CEG includes the following:

(1) Power Distribution Unit. The PDU provides prime power control and protection for the terminal as well as for each CEG drawer unit.

(2) Terminal Control Unit. The TCU features a 25-line plasma panel display and a 20-keypad and is the operator interface for control of the terminal and communications functions. Remote operation of the terminal is also permitted by an optional remote terminal control unit (RTCU), which is identical to the TCU. In either case, data are displayed simultaneously on both units so operation of the terminal can be monitored at either display.

(3) Terminal Control Processor-Modem. The TCP provides network and terminal control, including acquisition and antenna control functions. The modem performs multiplexing/demultiplexing, coding/decoding, interleaving/deinterleaving of the user and control data, and generates the different modulation and demodulation waveforms.

(a) TCP. The TCP contains the high-level RP-1600 processor that executes the software for terminal and multiple-access control. The TCP software handles initialization, operator interface, multiple-access control, antenna control, pointing and ranging prediction, system status, nonoperating test, and operating mode control. The TCP uses nonvolatile RAM for nonvolatile storage of critical data. The TCP also contains the interfaces to external systems such as the navigation subsystems (SINS/MK-19), time-of-day (cesium standard), and submarine reportback message and auxiliary TTY input and output.

(b) Modem. The modem contains baseband interface and TRANSEC circuitry. It also contains the hardware and firmware for MILSTAR waveform modulation/demodulation of data and C2 (uplink signaling orderwire)/C3 (downlink signaling orderwire)/AROW (acquisition reportback orderwire) control signaling, as well as transmission of power probes for uplink acquisition and the correlation of synchronization hops for downlink acquisition. The baseband interface CCAs are implemented with one FDX primary, one FDX secondary, and one receive-only port per card. Four baseband cards are supplied for the ship and shore terminals and two for submarine terminals.

(4) Microwave Processor and Antenna Position Control Unit. The MWP generates the frequency hopped FSK uplink to an RF signal, an LO signal for dehopping the received signal, and the other required frequencies for the transmitter and receiver derived from a highly stable frequency reference. The APCU controls the pointing of the antenna.

(a) MWP. The MWP contains the 5-MHz rubidium frequency standard, uplink and downlink frequency synthesizers, and the microwave receiver. The synthesizers use a mix of a direct digital synthesizer to provide fine frequency steps and a mix/divide synthesizer implemented at L-Band to provide an output of 6.4 to 7.4 GHz with fast switching (less than 200 ns) and low spurious noise (less than -55 dBc typical). The digital synthesizer provides an output in the 2-6 MHz range with steps less than 1 MHz. The microwave receiver contains a receive signal switch that is used in the ship terminal to select the receive signal from the two antennas.

(b) APCU. The APCU contains servo amplifier and control circuits for two ship pedestals or one shore pedestal or one submarine pedestal. In the ship/shore APCU, a gyro loop is provided for inertial stabilization of the antenna to compensate for platform motion, and a position loop is provided to control pointing of the antenna to a point in space relative to stabilized platform. In the submarine terminal, smaller servo-amplifiers are required.

b. High-Power Amplifier. The HPA frequency translates and amplifies the communication signal for transmission to an external antenna subsystem. The HPA contains an RF upconverter, traveling wave tube amplifier, high- and low-voltage power supplies, and control, protection, and monitoring circuits. The HPA contains the frequency conversion and amplification elements for the Q-Band uplink signal. The microwave processor output is upconverted to Q-Band using one of two local oscillator frequencies, thereby increasing the total transmit bandwidth to 2 GHz.

c. Antenna Group. A three-axis (elevation, over cross-level, and over train) antenna pedestal provides optimum hemispherical coverage for each installation. The ship and shore antennas use dichroic subreflectors with a CONSAN tracking system. The submarine antenna uses open-loop pointing. The entire structure is enclosed in a fiberglass radome to meet environmental overpressure requirements.

(1) Ship Antenna Pedestal Group. Each shipboard antenna pedestal group contains the three-axis pedestal configured for minimum swept volume and best mechanical integrity. The antenna dish is 34.5 inches in diameter. The antenna group also contains a radome, the LNA, and downconverter. Coax cabling carries the received signal to the CEG.

(2) Shore Antenna Pedestal Group. The shore terminal utilizes a pedestal nearly identical to the shipboard unit which, when limited in elevation angle coverage to 90 degrees, supports the 6-foot diameter antenna and can be driven by the same servo amplifiers as used in the shipboard APCU. The pedestal waveguide, cables, electronics, and feed are identical to the shipboard system.

(3) Submarine Antenna Pedestal Group. The submarine antenna pedestal uses a three-axis configuration and a 5.5-inch diameter antenna. The submarine LNA is the same as that used in the ship and shore terminals and is mounted behind the feed. Because of space considerations, the downconverter is located at the base of the pedestal.

(4) Antenna Transmit Switch. In the ship terminal, the use of two antenna pedestals is required to provide optimum hemispheric coverage without superstructure blockage. The antenna transmit switch is used to send the HPA output signal to the active antenna. It is a fast transfer mechanical switch that operates under full power, tapering the power down to one antenna as it tapers the power up to the other.

ANNEX C TO APPENDIX B TO ENCLOSURE D

ARMY MILSTAR TERMINALS

1. Description

a. Configurations. Army EHF communications will be supported by two types of Milstar ground terminals. Single channel communications will utilize the AN/PSC-11, Single Channel Antijam ManPortable Terminal (SCAMP). Multichannel communications will utilize the AN/TSC-154, Secure, Mobile, Antijam, Reliable Tactical Terminal (SMART-T).

b. AN/TSC-154. The SMART-T is a transportable, tactical satellite communications terminal that operates with the Milstar satellite LDR and MDR EHF communications payload. It will provide multichannel range extension for MSE at division and corps-levels over the Milstar satellite constellation. It can also operate over LDR EHF packages on FLTSAT and UFO. SMART-T, using GPS satellites to obtain time and location data, will operate in view of geosynchronous satellite orbits of all inclinations (from geostationary to highly inclined) using spot, agile, area, and earth coverage beams.

(1) The SMART-T will process data and voice communications at both MDR and LDR simultaneously. The SMART-T will replace all of the AN/TSC-85Bs and AN/TSC-93Bs currently deployed at Corps and Divisions. It will be used during all phases of Army operations as well as in contingencies. This terminal will provide initial connectivity between selected ECB ACUS node centers, large extension nodes, and small extension nodes. The SMART-T will satisfy any ACUS multichannel link requirement that cannot be met by line-of-sight equipment because of terrain or distance restrictions. Additionally, the SMART-T enhances MSRT communications on-the-move capability by allowing RAUs to be emplaced farther from node centers. The SMART-T will meet the need for a highly flexible and mobile long distance communications terminal to satisfy requirements for ACUS range extension on the extended battlefield.

(2) The SMART-T terminal is a member terminal, part of the predefined Milstar system, which can simultaneously act as a member of the network, a communications controller, and an antenna controller. It

may also simultaneously participate in LDR networks, MDR networks, and point-to-point calls. Member terminals log onto the Milstar payload, join networks and report status to ISYSCON. SMART-T s are among the first terminals that have the inherent flexibility to participate in the global grid.

(3) The SMART-T will support up to four simultaneous MSE digital trunk groups (DTG) data streams at 256-, 512-, or 1,024-Kbps, full-duplex. Two of these four ports will also support an MSE DTG at 4,096-Kbps each. Additionally, the SMART-T will support up to four simultaneous MDR users, with each user communicating at 4-, 8-, 9.6-, 16-, 19.2-, 32-, 64-, 128-, and 256-Kbps, half-duplex. It will support up to four simultaneous LDR users, with each user communicating at 75-, 150-, 300-, 600-, 1200-, and 2400-bps, half- and full-duplex. The SMART-T will be configurable for either MDR or LDR operation, or for simultaneous LDR/MDR operation via the operator interface. It can accommodate any mixture of simultaneous LDR and MDR users that can be time-division multiplexed within the uplink data frame. Communications capacity is a function of data rate and uplink modulation mode for each of the users.

(4) The SMART-T consists of a HMMWV, pallet, generator, antenna, RF equipment, associated electronics, operator interface device with cable, remote interface device with cable, LDR Interface Device (LID) with cable, AC-to-DC converter, chemical protective devices, and support equipment. The SMART-T will be able to operate and survive in a biological and chemical attack environment, as well as in a severe electronic warfare and/or electromagnetic pulse (EMP) environment.

(5) The capability for unattended operation, already an established standard in the commercial world, will be a SMART-T operational requirement. The terminal will have a set-up and tear-down time of within 30 minutes and have C130 roll-on roll-off capability to keep pace with the supported unit. The SMART-T will provide a highly sophisticated communications capability with reduced manpower. This greatly increases the SMART-T s utility without the penalty of increased force structure.

c. AN/PSC-11. The Single Channel, Anti-jam, ManPortable Terminal (SCAMP), AN/PSC-11, is designed to interface with the Milstar satellite low data rate payload. It can also operate over EHF packages on FLTSAT and UFO. The terminal will operate in point-to-point network, and broadcast modes providing voice and data services at a maximum data rate of 2.4 kbps. The SCAMP will provide range extension for combat net radio in supporting army operations as well as special operations. It can provide data-only MSE range extension. The SCAMP terminal can be paged while in motion and will evolve into a communications on the move capability.

(1) The SCAMP program is divided into SCAMP Block I and SCAMP Block II. The SCAMP Block I will be used for critical command and control communications between headquarters elements and their major subordinate commands. The Block I provides up to four simultaneous point-to-point, network, or broadcast voice and data services. The Block I terminal will weigh approximately 37 pounds. The SCAMP Block II will provide point-to-point and combat net radio range extension for conventional and special operations forces. A soldier with full battle load will be able to carry a SCAMP Block II terminal which will evolve from the current 37 pound weight to the desired 12-15 pounds.

(2) SCAMPs will be user-owned and operated. Set-up and tear down time is within ten minutes. It is interoperable with all Milstar terminals, including those of other Services, and has embedded Transmission Security/COMSEC and Global Positioning System (GPS). The SCAMP has anti-jam and LPI/LPD and exploitation capabilities to reduce the effectiveness of electronic warfare and the possibility of destruction. SCAMP can communicate with SMART-T through the LDR port. Users of SCAMP will be located at echelons Corps and below. Ideally, the SCAMP terminals will be used for critical command and control between headquarters elements and their major subordinate commands.

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APPENDIX C TO ENCLOSURE D

UHF SATELLITE SYSTEMS

1. Introduction. UHF satellite systems provide the joint tactical community with a capability to support special purpose point-to-point circuits. UHF satellite networks include the Air Force Satellite Communications (AFSATCOM) and Fleet Satellite Communications (FLTSATCOM) networks. Normal access for joint exercise contingencies is through the AFSATCOM wideband channels supported by UHF transponders. These transponders are located on the FLTSATCOM satellites and Satellite Data Systems (SDS) satellites. Because these satellites are also shared by many users, a control mechanism has been established for accessing and using these facilities. DSN facilities can be extended at selected UHF terminal locations. In addition to the AN/WSC-3, the AN/PSC-3, AN/VSC-7, LST-5B, and HST-4A satellite terminals are described in this appendix.

2. UHF Satellite Systems

a. The UHF satellite system is depicted in Figure D-C-1. As indicated, the AN/MSC-71 UHF satellite terminal is used in this network. This equipment operates in both the 5-kHz and the 25-kHz modes. This UHF network provides for either point-to-point or netted operations supporting either secure voice or secure TTY as depicted in Figure D-C-1. Secure voice is provided by using the KY-57 VINSON and the AN/GSC-38 16-Kbps modem. Secure TTY, an alternate means of communications, is provided using the AN/UGC-129(V)1 TTY terminal and KG-84( ), as depicted in Figure D-C-1. A TTY circuit configuration and KG-84( ) switch settings to support this requirement are discussed in CJCSM 6231.03A.

b. Note that control of the satellite power budget is the responsibility of the appropriate satellite controller. The system planner or engineer should ensure that the equipment is installed and operated with sufficient received signal level to support the required signal-to-noise ratio for the particular mode of operation.

3. UHF Satellite Access Request. Table D-C-1 depicts the message format used to request access to the UHF satellite network.

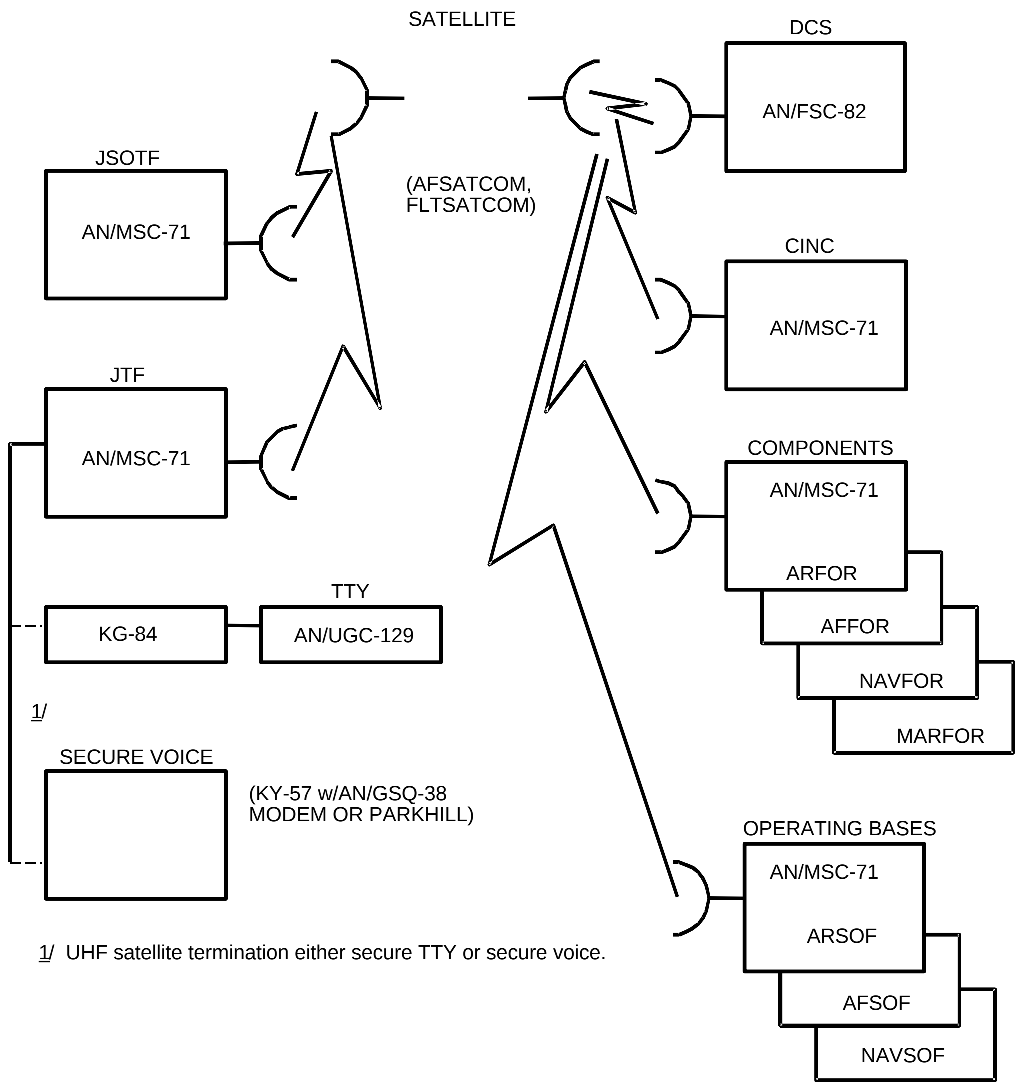

Figure D-C-1. UHF Satellite Network

Table D-C-1. UHF Satellite Access Request

Part 1A--General Request Information	
1	Requesting agency and location.
2	Number and types of access (narrowband/wideband)
3	Purpose of access
4	Geographical limits of access: maximum latitude and longitude (if airborne).
5	NCE location and name of using agency, if different from 1A-1 above.
6	NCE point of contact (person, ops center, command post having immediate contact with NCE)- primary and alternate names and DSN numbers. (These contacts must be available during the entire access period.) If the access is classified, a secure voice number must be provided.
7	Access periods start and stop times (ZULU). Indicate acceptable alternate time periods if possible.
8	Remarks, name, and DSN number of requestor if other than Item 6. Name of person contacted if this access was approved by telephone. Include other information as necessary. (Also include POC for administrative or coordination purposes if different from Item 6.)
Part 1B--First Request and Change Information	
9	Type and nomenclature of satellite terminal equipment.
10	Location of all satellite ground terminals within the operational net.

Table D-C-1. (Cont'd)

11	Effective radiated power capability (transmitter output power, plus antenna gain, minus cable loss) of each terminal. A- Maximum B- Minimum
Part II--Narrowband Channel Access	
12	Channel type requested: Regenerative (FLTSATCOM channels 1 and SDS channels 1-12) or nonregenerative (FLTSATCOM channels 8-12).
13	Data rate and type of modulation (nonregenerative only).
Part III--Wideband Channel Access	
14	Bandwidth of transmitter.
15	Data rate and type of modulation to be transferred.
16	Type of wideband access requested (AFSATCOM code or fixed frequency.

Also see Appendix A to Enclosure G of CJCSM 6231.07B, for additional information. Primary control centers (PCCs) for this network are listed in Table D-C-2. Characteristics of the AN/WSC-3 used as a UHF ground terminal in this net are discussed in paragraph 4.

4. AN/WSC-3 UHF Satellite Terminal. The AN/WSC-3 is a UHF satellite LOS communications terminal that is deployed in several configurations to support CRISIS/quick reaction communications requirements. The configurations include the AN/TSC-96, used by the Marine Corps; the AN/TSC-102, used by the Air Force; the AN/FSC-82, used at strategic locations worldwide; and the AN/MSC-71 UHF satellite terminal, package for the JCSE by the Navy. The AN/WSC-3 operates with the FLTSATCOM system or AFSATCOM system, depending on the mode of operation selected, or alternatively is used in an LOS mode for point-to-point ground communications.

a. Functional Description. The AN/WSC-3 is a highly flexible UHF terminal capable of operation in the FM and AM modes. Technical characteristics of the AN/WSC-3 are outlined in Table D-C-3. In the AM mode, it provides either narrowband (NB) or wideband (WB) type emissions. In the FM mode it provides FM, FSK, and PSK type emissions. The AN/WSC-3 interoperates with a variety of terminal equipment depending on its mode of operation. Audio input can be

Table D-C-2. Primary Control Center (PCC) Satellite Assignment

Satellite	PCC	Alt PCC
15 ° West	Brandywine	March AFB
23 ° West	Brandywine	March AFB
100 ° West	March AFB	Brandywine
105 ° West	March AFB	Brandywine
172 ° East	Kadena AFB	March AFB
LES 8/9	Brandywine	Mildenhall

Table D-C-3. AN/WSC-3 Technical Characteristics

Characteristic	Parameter
Frequency Range (MHz)	225-400
Number of Channels Preset Channels	7,000 in 25 kHz increments 20, remote or locally controlled
Emission	NB AM, WB AM, FM, FSK, PSK
RF Power Output (watts)	30 AM, 100 FM
RF Output Control	FM level adjustable down to less than 1 watt
Transmit/Receive Turn Around	7 ms maximum
<u>Modem</u> Bit Error Rate (FSK) Bit Error Rate (PSK) 	<u>E_b/N_o</u> <u>BER</u> 13.0 1 in 10^3 15.0 1 in 10^5 11 1 in 10^3 9.5 1 in 10^3

provided either locally (handset) or remotely from a telephone set. Data transmission is supported at 75 bps FSK or at 75, 300, 1,200, 2,400, 4,800, or 9,600 bps PSK. Secure voice is supported at 2,400 bps using the CV-333 Vocoder or the PARKHILL KY-65/75 on the remote audio lines.

b. Interfaces. The AN/WSC-3 provides the interfaces listed in Table D-C-4.

Table D-C-4. AN/WSC-3 Interfaces

Interfaces	Remarks
Audio	
Local	Handset (H-33)
Remote	Telephone lines four-wire, 600 ohms, -3 dBm
Data	
FSK	75 bps
PSK	300, 1,200, 4,800, and 9,600 bps
Secure Voice	2,400 bps from CV-333 Vocoder

5. AN/PSC-3 and AN/VSC-7 Single Channel UHF SATCOM Radio Terminals. These terminals provide a satellite communications capability for primarily ARSOF and Army Ranger units for use in forward areas or behind enemy lines.

a. AN/PSC-3. The AN/PSC-3 is a manportable, battery operated, half-duplex UHF tactical satellite terminal. It provides two-way voice (secure and nonsecure) and data communications through satellite relay (SAT) or LOS modes. The terminal uses an omnidirectional, low gain whip antenna for reception of selective and/or conference calls from a satellite relay station and for reception and transmission of LOS signals. A directional, medium gain antenna is used for satellite communication. The AN/PSC-3 is capable of being paged while in motion providing visual and audible indications to the operator. The AN/PSC-3 will interface with an OA-8990 digital message device group at 300 or 1,200 bps. The 2,400 mode will interface with other MIL-STD-188C low-level devices at 2,400 bps. The OA-8990 is a handheld, self-contained unit providing a means to enter and retrieve digital and alphanumeric information in a free format style. Figure D-C-2 is a block diagram of the AN/PSC-3.

b. AN/VSC-7. The AN/VSC-7 is a vehicular mounted version of the AN/PSC-3. A high gain antenna is used for ground-to-satellite NCS communications. A control converter assembly is referred to as the NCS applique that provides base station capabilities when interfaced with the RT-1402 to configure the NCS. The AN/VSC-7 serves as a net control station for up to 15 AN/PSC-3 terminals. The NCS also interfaces with the OA-8990 digital message device group.

c. AN/PSC-3 and AN/VSC-7 Terminal Components. The principal components of the AN/PSC-3 and AN/VSC-7 are listed in Table D-C-5.

Table D-C-5. AN/PSC-3 and AN/VSC-7 Components

Component	AN/PSC-3	AN/VSC-7
Receiver-Transmitter, RT-1402	X	X
Handset, H-250	X	X
Antenna Medium Gain, AS-3567	X	-
Antenna Low Gain, AS-3566	X	X
Antenna High Gain, AS-3568	-	X
Control-Converter, C-11119	-	X
Mounting Base, MT-1029	-	X

d. AN/PSC-3 and AN/VSC-7 Technical Characteristics. See Table D-C-6.

6. Miniature Satellite Transceiver, AN/PSC-7. The AN/PSC-7 is a lightweight and portable UHF SATCOM transceiver. Technical characteristics are listed in Table D-C-7.

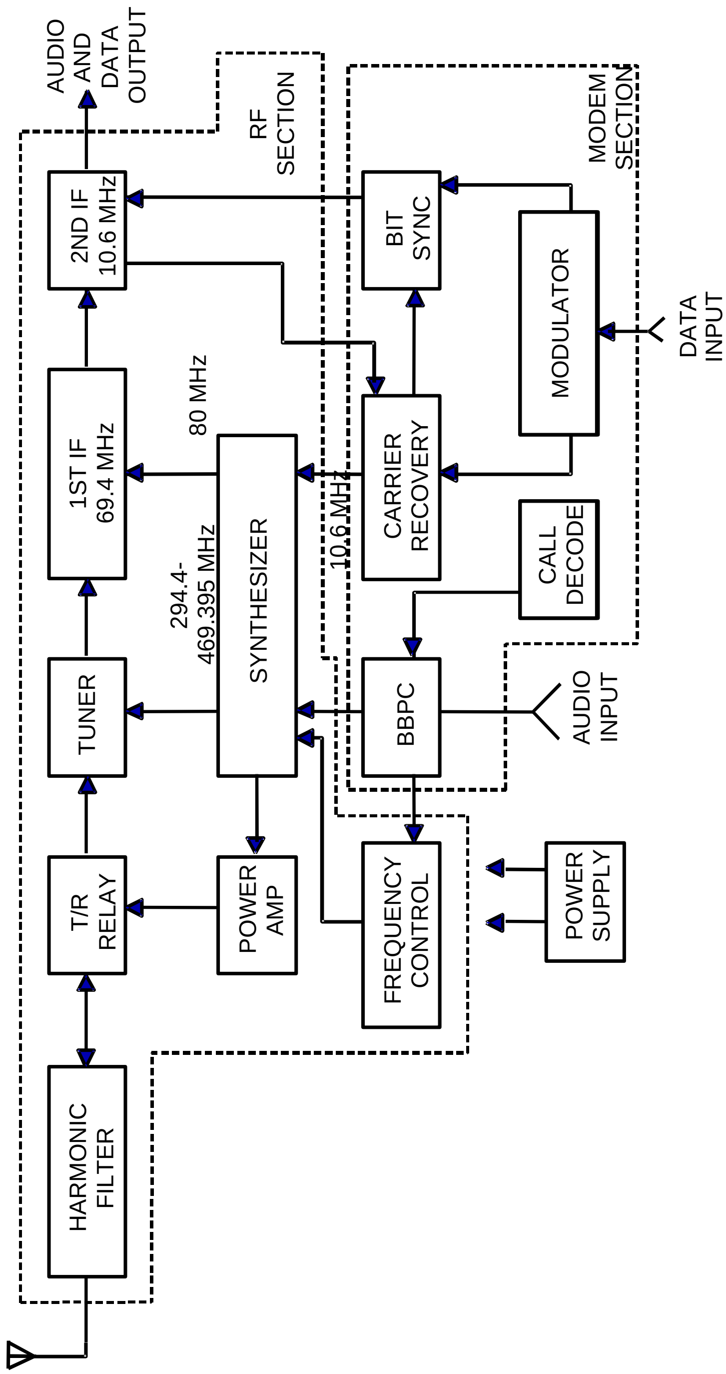

Figure D-C-2. AN/PSC-3 Functional Block Diagram

Table D-C-6. AN/PSC-3 and AN/VSC-7 Technical Characteristics

Characteristic	Value
Receiver/Transmitter	
Frequency Range	225-399.995 MHz
Power Output	Continuously variable from <1 Watt to 27.8 (SAT) Continuously variable from <1 Watt to 2 Watts (LOS)
Bandwidth	5 kHz (Data) 25 kHz (Voice)
Channel Spacing	5 kHz (SAT) 25 kHz (LOS)
Modulation Types	FM, FM-FSK, BPSK, and DBPSK
Channels (Messages)	Send and receive conference calls and transmit and receive one of 15 conference calls.
Frequency Stability	1 part in 10^6
Harmonic Attenuation	40 dB minimum
Image Rejection	Not less than 60 dB
Tuning Increments	5 kHz
NCS Applique	
T/R Switching	Automatic
Receive Signal Insertion Loss	< 3 dB into 50 ohms
Power Amplifier Output	Continuously variable from less than 1 Watt up to 27.8 Watts ± 2 dB and continuous if desired.
Low Gain (Whip) Antenna	
Frequency Range	225-400 MHz
VSWR	1:5:1
Orientation	Omnidirectional--0 to 90°
Gain	-2 dB (240 to 318 MHz) -4dB (225-240 MHz and 318 to 400 MHz)
Medium Gain Antenna	
Frequency Range	240-400 MHz
Beamwidth	85°
Orientation	Directional
VSWR	1:5:1

Table D-C-6. (Cont'd)

Characteristic	Value
Gain	6 dB (240-318 MHz) 5.5 dB (318-400 MHz)
High Gain Antenna	
Frequency Range	240-400 MHz
Beamwidth	77°
Orientation	Directional
VSWR	1:5:1
Gain	8 dB (240-318 MHz) 6 dB (318-400 MHz)

Table D-C-7. AN/PSC-7 Technical Characteristics

Characteristic	Value	
Transceiver Characteristics		
Frequency Range	225-400 MHz	
Channels	5 kHz steps (SAT) 25 kHz steps (LOS)	
Preset Channels	5 XMIT 5 RCV stored in EEPROM (no preset battery required)	
Modulation & Modes	AM voice FM voice-8 kHz peak deviation AM-16 Kbps (KY-57/58) BPSK-1,200 &2,400 bps SBPSK (differentially encoded)- 1,200 & 2,400 bps AM beacon @ 243.0 MHz with continuously swept tone 1,500 to 300 Hz	
Frequency Stability	1 ppm	
Tun Around Time (Rec to Trans/Trans to Rec)	50 msec	
Satellite Modem Characteristics		
Carrier Acquisition	1,200 bps	2,400 bps
dBm	-134	-131
C/kT	37	40

Table D-C-7. (Cont'd)

Characteristic	Value	
BER @ 1 x 10^{-3}	1,200 bps	2,400 bps
dBm	-132	-131
C/kT	39	42
BER @ 1 x 10^{-5}	1,200 bps	2,400 bps
dBm	-128	-125
C/kT	43	46
Receiver Characteristics		
Sensitivity (Typical)	FM voice: -118 dBm for 10 dBSINAD FM FSK- 16 Kbps (KY-57/58): -112 dBm for 7 dB SINAD AM voice: -110 dBm for 10 dB SINAD AM (KY-57/58): -112 dBm	
Noise Figure	< 2.5 dB typical, 4 dB max	
Spurious Responses	> 60 dB (above sensitivity)	
Intermodulation (3d order)	60 dB from two -70 dBm tones	
Transmitter Characteristics		
Power Output (1.5:1 VSWR)	< 1 to 22 Watts (SAT) continuously variable from 1 W to full power < 1 to 2 Watts (LOS) continuously variable from 1 W to full power	
Harmonics	-40 dBc max	

7. Lightweight Satellite Transceiver, LST-5B

a. General. The LST-5B is a manpack, UHF AM/FM transceiver used for LOS or SATCOM communications. It is suitable for manpack, vehicular, or fixed-station applications. The radio set is a microprocessor-controlled, fully synthesized transceiver. It is capable of operating with a variety of other equipment.

b. LST-5B System Components

(1) Transceiver.

(2) Antenna. Any antenna with a 50 ohm, 3.0 maximum VSWR, and 20 watt capability operating in the UHF band can be used.

(3) Battery case.

(4) Power supply.

(8) Cable assembly (KY-57)

(9) Cable assembly (KY-58, -65, -75).

c. Technical Characteristics. See Table D-C-8.

8. HST-4A, Tactical UHF Satellite Terminal

a. Introduction. The HST-4A is a miniaturized commercial, single-channel UHF manpack satellite transceiver used primarily by the Marine Corps, but also by the other Services. It can be used to communicate through a TACSATCOM satellite to another HST-4A, AN/PSC-3, or any other UHF SATCOM terminal. It can also be used to communicate directly to another VHF radio by LOS paths.

b. Features and Capabilities

(1) The HST-4A can use an omnidirectional low gain antenna for reception from a satellite relay station and for reception and transmission of LOS signals. A directional, medium gain, tripod-mounted antenna is used for SAT operation.

(2) Operating Modes

(a) AM.

(b) PM.

(c) X mode enables FM-FSK interface with the KY-57 in cipher text only.

(d) D1.2 mode operates in 1,200 bps using shaped BPSK and interface with the digital message device group (DMDG).

(e) D2.4 mode operates in 2,400 bps using shaped-biphase shift keying and interface with the ANDVT.

Table D-C-8. LST-5B Technical Characteristics

Characteristic	Value
General Characteristics	
Frequency Range	225-399.995 MHz
Channel Spacing	5 and 25 kHz
Frequency Accuracy	1 ppm over operating temperature for 1year
Preset Channels	9
Modulation	AM and FM, voice, cipher, data, and beacon
	1,200 BPSK
	2,400 SBPSK data, nondifferential or differentially encoded data
Operating Modes	BPSK/SBPSK
Plain Text (PT)	AM or FM
Cipher Text (CT)	AM or FM
T/R	Relay mode, receive and transmit on 1 of 9 preset channels.
Beacon	Transmit an emergency audio sweep on any selected frequency.
Scan	Scan any 2 of 9 preset channels. Transmit on a third preset channel.
	75 selective and 1 conference call codes.
SELCALL	
Receiver Characteristics	
Sensitivity	FM Plain text -119 dBm
S+N	FM Cipher text -117 dBm
10 dB S+N	AM Plain text -110 dBm
N	AM Cipher text -112 dBm
Noise Figure	4 dB (typical)
Image Response	70 dB above sensitivity
Spurious Response	Manual adjust, carrier-level squelch

Table D-C-8. (Cont'd)

Characteristic	Value
Transmitter Characteristics	
Power Output	
FM, PM	Adjustable in 2 W steps from 2 to 18 W
AM	Low: 2 W, High: 5 W
Spurious Outputs	60 dB below carrier (typical)
Spectral Containment	95% in a 5 kHz BW @ 2400 BPSK
Transmitter Noise Floor	-110 dBm/Hz typical @ 10 MHz
Modem Characteristics (240-325 MHz)	
Carrier Acquisition	150 ms maximum, +700 Hz offset C/kT = 41 dB @ 1200 bpsk and 2400 SBPSK C/kT@ 10^{-3} BER = 39 db @ 1200 BPSK Nondifferential: 43 dB @2400 SBPSK Sensitivity for 10^{-3} -131 dBm at 1200 BPSK BER, typical -127 dBm SBPSK Data Interface Levels: MIL-STD-188-114 unbalanced.

(f) GR enables operation of the guard channel AM emergency transceiver.

(g) BN enables automatic operation of the AM frequency beacon.

(3) Antennas. The medium gain antenna AS-3567 is directional and used for SAT communications. It includes a tripod for support and a mechanism for adjusting elevation. The whip antenna AS-3566 is used for LOS communications.

c. HST-4A Technical Characteristics. See Table D-C-9.

Table D-C-9. HST-4A Technical Characteristics

Characteristic	Value
System Characteristics	
Frequency Range	225-399.995 MHz
Channel Spacing	5 kHz FM, X, D1.2, or D2.4 data modes 25 kHz AM mode
Preset Channels	5 XMIT 5 RCV stored in EEPROM (no preset battery required)
Guard Channel	243.000 MHz
Data Rates With Built-in Modem Wideband Secure Voice	 1,200 or 2,400 bps; shaped BPSK, DBPSK 16 Kbps: FM-FSK and AM-ASK
Receiver Characteristics	
Sensitivity	FM voice: -122 dBm for 7 dB S+N/N AM voice: -110 dBm for 10 dB S+N/N FM-FSK: -118 dBm AM-ASK: -110 dBm
IF Bandwidth	30 kHz/4.7 kHz
Noise Figure	2.5 dB typical, 4 dB max
Spurious Responses	60 dB (above sensitivity)
Image Rejection	50 dB

Table D-C-9. (Cont'd)

Characteristic	Value
Transmitter Characteristics	
Power Output	Selectable 3.5 W (low power) nominal or 15 W minimum (high power) in FM, X, 1,200 and 2,400 bps. 3.5 W in AM, Guard, and Beacon
Modulation Types	AM voice FM voice: 8 kHz deviation FM-FSK: 16 Kbps secure voice AM-ASK: 16 Kbps secure voice BPK: shaped DBPSK: shaped AM transmit @ 243.0 MHz with continuously swept tone
Beacon	1,500 to 300 Hz
Medium Gain Antenna	
Frequency Range	240-400 MHz
Beamwidth	85°
Orientation	Directional. Elevation 0-90
VSWR	1.5:1
Gain	6 dB (240-318 MHz) 5.5 dB (318-400 MHz)
Whip Antenna	
Frequency Range	225-400 MHz
VSWR	1.5:1
Orientation	Omnidirectional
Gain	-2 dB (240-318 MHz) -4 dB (318-400 MHz)

9. <u>AN/PSC-5 Spitfire Terminal</u>. The Spitfire is the replacement for all UHF single-channel tactical satellite (SCTACSAT) terminals. Figure D-C-3 is an LOS and SATCOM terminal which operates in the 30-400 MHz frequency range and provides both voice and data communications. For SATCOM operations (225-400 MHz), the terminal operates both wideband (25-kHz channels) and narrowband (5-kHz channels) in the dedicated and DAMA modes. The AN/PSC-5 is a SCTACSAT, and is part of the Combat Net Radio (CNR) system of communications. As such, it provides the BLOS connectivity unavailable through the other CNR systems. The Spitfire provides data-rates of 75-bps to 16-Kbps for baseband data traffic. Voice traffic is at either 2.4 or 16 Kbps, depending upon the type of channel authorization and DAMA configuration of that channel. DAMA orderwire traffic is transmitted at 75-bps. Specific, selectable data rates are listed in Table D-C-10 for each mode of operations. The terminal possesses embedded COMSEC to allow the encryption of voice, data, and orderwire transmissions. For voice and data encryption, the embedded COMSEC capabilities include KY-57/58, KG-84, and ANDVT/KYV-5 (compatible with the KY-99 and KY-99A). Orderwire transmissions, used in DAMA for control, are encrypted by the terminal via the embedded KGV-11. Additionally, the terminal comes with a retransmission capability for SINCGARS, used for range extension of SINCGARS nets.

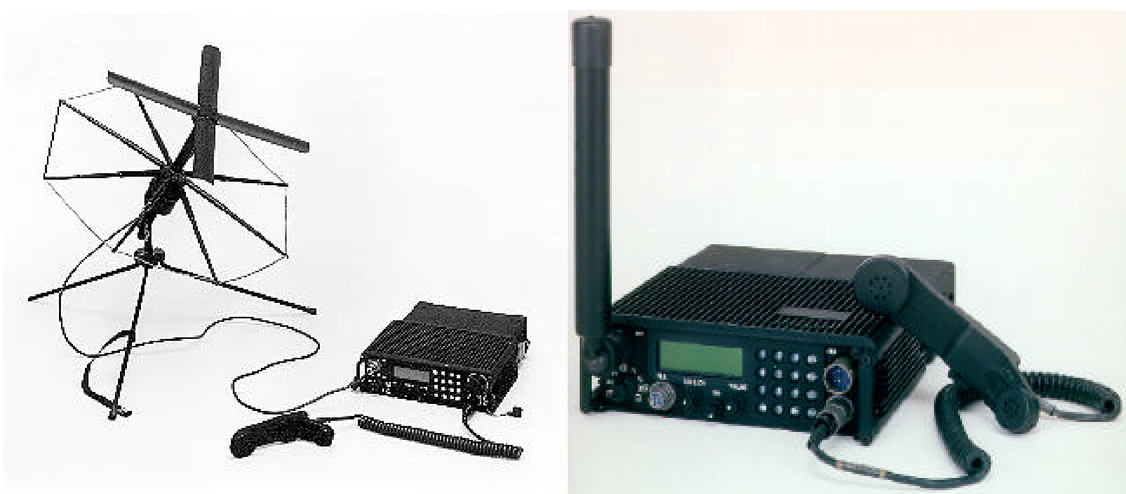

Figure D-C-3. Spitfire with SATCOM and LOS Antenna

Table D-C-10. Selectable Data Rates

Modes	Data Rates
LOS	16 Kbps
SATCOM	1200 bps, 2400 bps, 9600 bps, and 16 Kbps
DAMA	75 bps, 300 bps, 600 bps, 1200 bps, 2400 bps, 4800 bps, 9600 bps, and 16 Kbps

a. Function Description. The Spitfire terminal is menu-driven and allows for presetting up to 19 operating modes; six for SATCOM operation, six for LOS operation, six for DAMA operation, and one for BEACON (LOS only) mode. The terminal has a Built-in-Test (BIT) capability available upon start-up and on user request. There are several options available to either the user or maintainer within the BIT menu, which include SATCOM loopback and battery levels.

b. COMSEC. Loading and updating the COMSEC keys is conducted via the mode switch and menu. Over-the-air-rekey (OTAR) (receive only) is available for KY-57 and KY-99-compatible embedded crypto. The embedded KG-84 cannot be re-keyed via OTAR but is capable of being updated. The capability is available for OTAR of the DAMA orderwire. Due to the limitation of the embedded KG-84, all six COMSEC key fill slots may be filled with KG-84 keys if this is the only COMSEC capability being utilized. The terminal is compatible with the KYK-13, KYK-15, KOI-18, and AN/CYZ-10 fill devices.

c. Spitfire Components. The components of the Spitfire are the RT, battery box, LOS antenna, handset (H-250/U), and six cables for connection to the SATCOM antenna, I/O devices, and range extension equipment, either with another Spitfire or with SINCGARS. The terminal is issued with a medium gain SATCOM antenna (AS-4326/P) and extension kit (MK-2799/U), although this is not part of the Spitfire Radio Set.

(1) The RT-1672/U(C) is the basic component of the Spitfire. It provides the user with a capability of multiband operations within the

frequency range of 30-400 MHz. Although it cannot perform the frequency-hopping capability in the SINCGARS bandwidth, the Spitfire will communicate with the SINCGARS terminals in both the LOS mode and when set up in an abbreviated retransmission mode. The distant end terminal will be in the Cipher Text (CT) mode and able to transmit and receive the messages sent within the SINCGARS network. This provides the user with a limited BLOS capability with SINCGARS equipment.

(2) Antennas. Two types of antennas are issued with the Spitfire. The LOS antenna is an omnidirectional antenna, optimized for use in the UHF frequency range. The satellite antenna and extension kit, AS-4326/P and MK-2799/U, provides a 6 to 11 dB gain, dependent upon the extensions added to the basic antenna. The satellite antenna also comes with two additional cables for connection to the terminal.

d. Spitfire Fielding. The Army distribution of the Spitfire will increase dramatically over previously fielded SCTACSAT terminals. Currently 40% of the 2,402 terminals are already fielded, with an additional 1,077 terminals approved for distribution throughout the Army and Special Operations Forces.

e. Ancillary Equipment. The terminal comes with six auxiliary cables. The cables are as follows:

(1) KL-43C/F (W1) interface cable assembly - six feet in length and .41 lbs. Ensure the software version in the KL-43C being used is Version 1.74 or higher.

(2) AN/PSC-2A (W2) Interface Cable Assembly - six feet in length and .53 lbs.

(3) DMDG (W3) Interface Cable Assembly - six feet in length and .34 lbs.

(4) AN/PSC-5 (W4) Retransmit Cable Assembly - 27.5 feet in length and 3.03 lbs.

(5) SINCGARS (W5) Retransmit Cable Assembly - 27.5 feet in length and 1.72 lbs.

(6) Satellite (W6) Antenna Cable Assembly - six feet in length and .19 lbs. Note that the SATCOM antenna provided with the Spitfire comes with its own coax cables, which can be used in place of the W6 when additional length is required.

(7) The total fielding package will also include a Cloning Cable. The cable is labeled W7, 422631-1 and is called the special purpose cable assembly. The NSN for it is 5995-01-297-9494. This cable will provide a cloning capability for the terminal. All information from the Presets will be transferred from one radio to another. This will not include COMSEC keys nor the information placed in the database. Users must ensure that each terminal is programmed with the proper Terminal Address and all other database information (guard lists, information response codes, etc.) once cloning is completed.

f. Mounts and Auxiliary Equipment. Several types of mounts and different pieces of auxiliary equipment have been identified for use with the Spitfire. The mounts will include both vehicular and aircraft requirements, based on input received from the various schools and users. Along with the mounts, there will be the necessary equipment to provide communications on the move, which includes, but is not limited to, antennas, power supplies, power amplifiers, power adapters, and cables.

g. Pre-planned Product Improvements. Representatives from the user community have identified requirements that would enhance the capabilities of the Spitfire. These requirements have been submitted to the appropriate agencies for research and development and future inclusion in the Spitfire package. These requirements include the following:

(a) HAVE QUICK II

(b) Embedded Global Positioning System (GPS)

(c) Improved Voice Recognition (MELP)

(d) Transmission of OTAR from the terminal

(e) KG-40

(f) Communications on-the-move and enroute in the DAMA mode

(g) Paging

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